MIT Technology Review

The climate issue

Vol 122 No 3 | May/June 2019 | $9.99 USD $10.99 CAD

Welcome to climate change

Mitigation

Why the battle to curb carbon emissions is losing ground

Adaptation

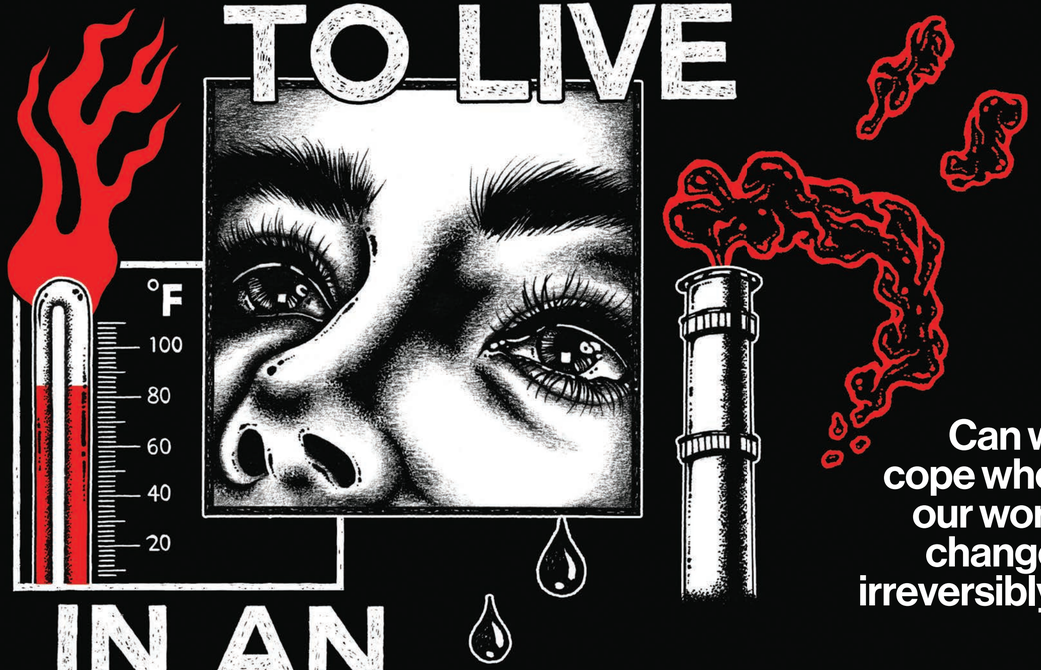
Technologies for living on a hotter, more dangerous planet

Suffering

A picture of life in the future for both the winners and the losers

06
0 74808 01308 1

LEARNING TO LIVE IN AN APOCALYPSE



BY ROY SCRANTON

ILLUSTRATIONS BY KELSEY NIZIOLEK

Can we cope when our world changes irreversibly?

The fantasy version of apocalypse always begins with the long-awaited event – a missile launch, escaped virus, zombie outbreak – and moves swiftly through collapse into a new, steady state. Something happens, and the morning after you're pushing a squeaking shopping cart down a highway littered with abandoned Teslas, sawed-off shotgun at the ready. The event is key: it's a baptism, a fiery sword separating past and present, the origin story of Future You.

Catastrophic global climate change, however, is not an event at all, and we're not waiting for it. We're living it right now.

In August 2018, in a summer of forest fires and shattered heat records, the strongest, oldest ice in the Arctic Sea broke up for the first time on record, presaging the final throes of the Arctic death spiral. In September 2018, the secretary general of the United Nations, António Guterres, gave a speech warning: "If we do not change course by 2020, we risk missing the point where we can avoid runaway climate change." The months following saw the US government crippled by a fight over whether to build a wall on the southern border to keep out climate change refugees, news that greenhouse-gas emissions have not decreased but in fact have accelerated upward, and a populist revolt in France sparked by opposition to a gas tax.

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We must go on

Like Plenty Coups, we face the destruction of our conceptual reality. Catastrophic levels of global warming are practically inevitable at this point, and one way or another this will bring about the end of life as we know it.

So we have to confront two distinct challenges. The first is whether we might curtail the worst possibilities of climate change and stave off human extinction by limiting greenhouse-gas emissions

warm-blooded mammalian apex predator like *Homo sapiens* surviving in significant numbers. Such a crisis could create a population bottleneck like other, prehistoric bottlenecks, as many billions of people die, or it could mean the end of our species. There's no real way to know what will happen except by looking at roughly similar catastrophes in the past, which have left the Earth a graveyard of failed species. We burn some of them to drive our cars.

Nevertheless, the fact that our situation offers no good prospects does not absolve us of the obligation to find a way forward. Our apocalypse is happening day by day, and our greatest challenge is learning to live with this truth while remaining committed to some as-yet-unimaginable form of future human flourishing—to live with radical hope. Despite decades of failure, a disheartening track record, ongoing paralysis, a social order geared toward consumption and distraction, and the strong possibility that our great-grandchildren may be the last generation of humans ever to live on planet Earth, we must go on. We have no choice.

Roy Scranton is the author of We're Doomed: Now What? (Soho Press, 2018) and Learning to Die in the Anthropocene. He teaches at the University of Notre Dame.


GREETINGS FROM
Florida
THE SUNSHINE STATE
Pensacola
Ft. Walton Beach
Destin
Panama City
Tallahassee
Cape San Blas
Jacksonvillle
Lake City
St. Augustine
Branford
Daytona Beach
Gainesville
Titusville
Cross City
Ocala
Orlando
Cape Canaveral
Melbourne
Tampa
Clearwater
St. Petersburg
Disney World
Bradenton
Vero Beach
Sarasota
Lake Okeechobee
Venice
Punta Gorda
Fort Myers
Palm Beach
Naples
Ft. Lauderdale
Hollywood
Everglades Nat. Park
Marco
Miami Beach
Miami
Coral Gables
Florida Keys
Key West
ATLANTIC OCEAN


I WAS HOPING FOR A COOLER DEATH
DENIAL IS SUICIDE
WE WOULD BE IN SCHOOL IF THE POLITICIANS WERE DOING THEIR JOB
STOP CLIMATE CHANGE OR WE'LL FIRE YOU
There IS NO Planet 'B' Let's change for climate sake!
IT'S OUR FUTURE


Why the Dali museum is a surreal shelter from the storm
1:58

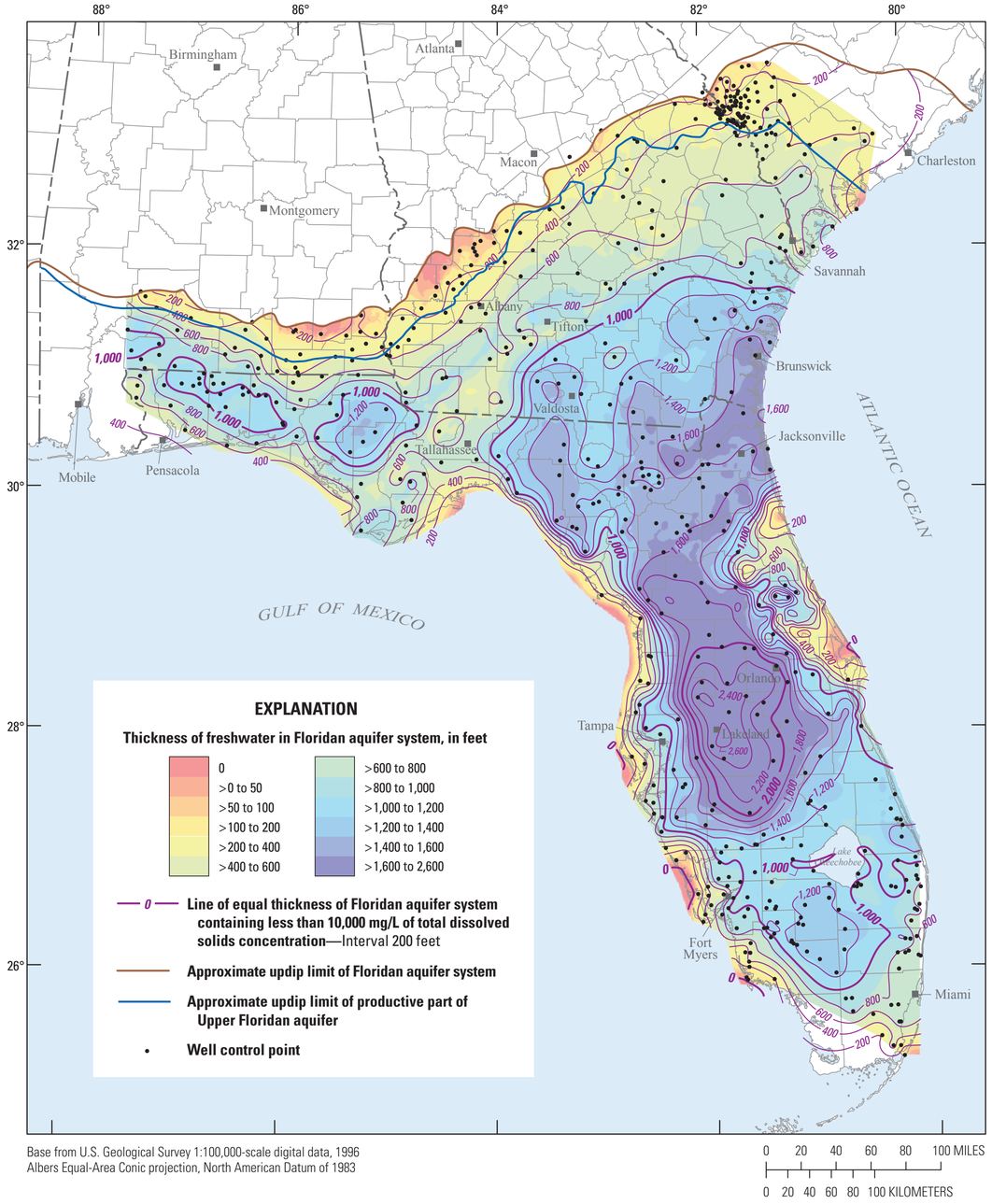


Figure 54. Estimated thickness of the fresh- and brackish-water zones of the Floridan aquifer system, southeastern United States.

WET SEASON, DRY SEASON

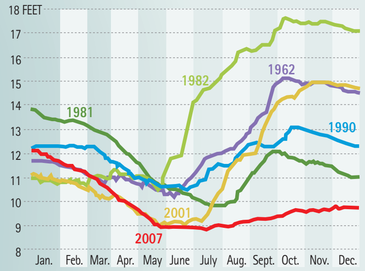
MANAGING EVERY DROP

Our central and south Florida weather can be one of extremes from droughts to hurricanes — sometimes in the same year! Our region has two seasons: the wet season, from June through October, when 70 percent of the year's rain falls, and most hurricanes occur; and the dry season, from November through May. We typically get an abundance of rain, about 52 inches a year, falling mostly in the wet season. But, Mother Nature isn't always typical and she does not always follow the wet/dry calendar. Knowing that we can expect two seasons, we can all be prepared to handle too little or too much rain.

SFWMD WATER MANAGERS

Engineers, meteorologists and water managers monitor weather conditions and water levels 24 hours a day from the District's "Control Room" at its headquarters in West Palm Beach. They use this data to determine optimal operation of the hundreds of water control structures throughout the system in times of heavy rain or drought — and all year long.

Lake Okeechobee Extreme Highs & Lows . . .



. . . in the same year!

Our Connected System

The South Florida Water Management District operates the regional water management system of canals, levees and water control structures and has, for more than 60 years, helped to lessen the impact of flood and drought. With more than 2,600 miles of canals and levees, about 1,300 water control structures and 66 pump stations, it is one of the largest water control systems in the world. The system connects to community drainage districts and hundreds of smaller neighborhood systems to effectively manage floodwaters during heavy rain and to move water to manage water supplies for cities, farms and the environment during drought.

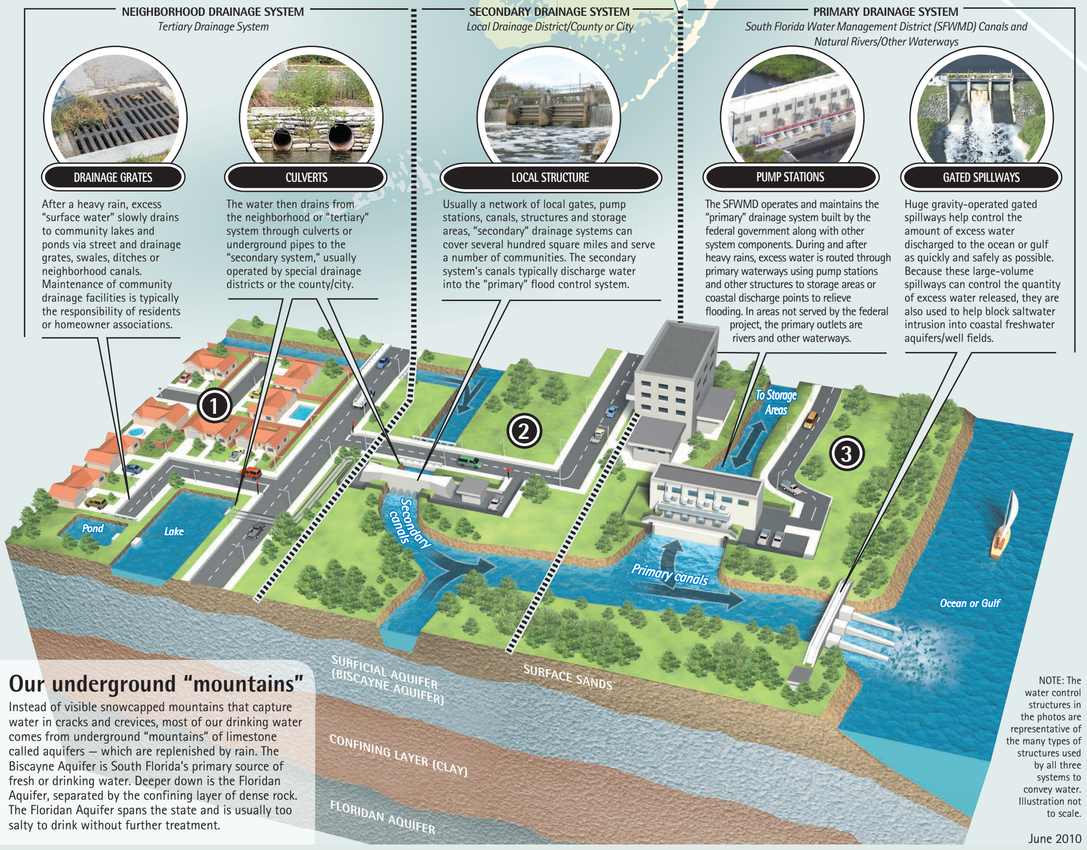
Extreme Drought

During drought, the South Florida Water Management District constantly monitors our water supply sources and storage areas such as ground (aquifers) and surface (lakes, wetlands, canals, ponds, etc.) water levels, including Lake Okeechobee and the Everglades Water Conservation Areas. These levels can fall fast because they are recharged by rainfall. When levels fall too low, the District declares a water shortage emergency imposing mandatory water use restrictions to stretch our limited water supplies and protect our natural systems. Depending on levels, the District also can move water from storage areas through the system to recharge public water supply well fields and prevent saltwater intrusion from tainting our drinking water.

When a Storm Approaches

Weather conditions and water levels are monitored around the clock, 365 days a year using state-of-the art technology and long-term climatic forecasting. The District opens flood gates and lowers primary canal levels if heavy rains are expected. In extreme conditions, the Emergency Operations Center is activated and coordinates with other governmental agencies.

KNOW THE FLOW: A THREE-TIERED SYSTEM



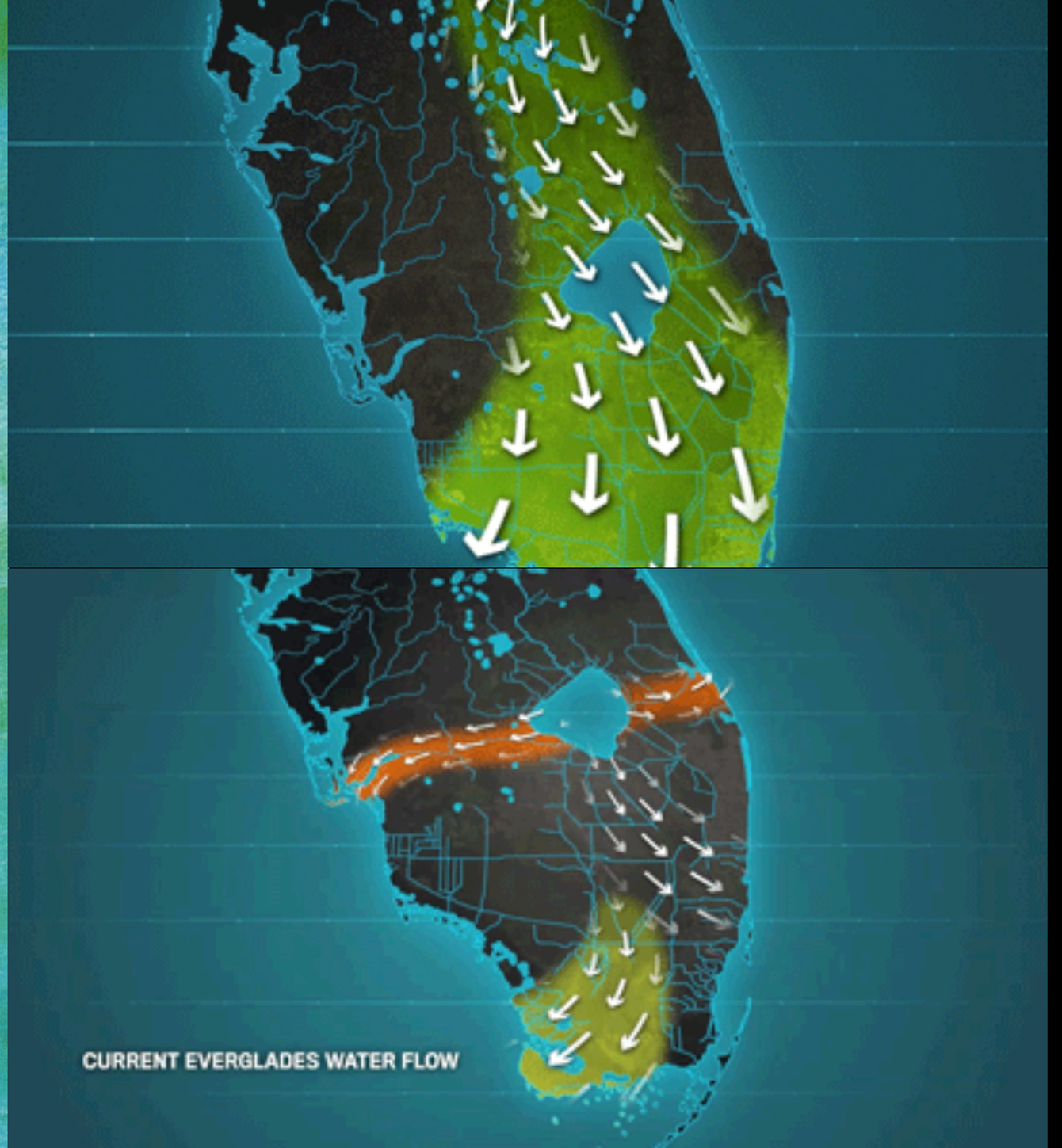
Our underground "mountains"

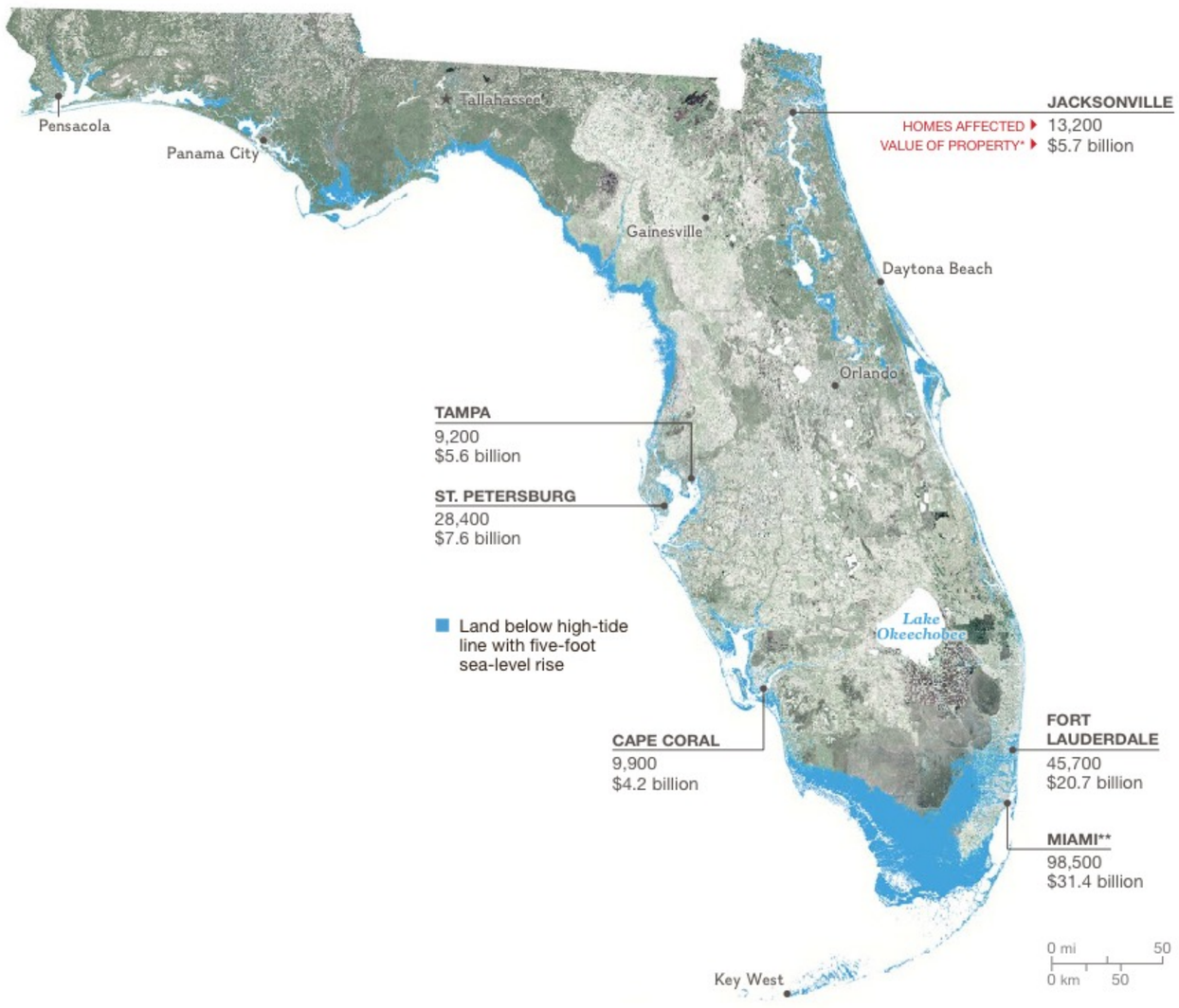
Instead of visible snowcapped mountains that capture water in cracks and crevices, most of our drinking water comes from underground "mountains" of limestone called aquifers — which are replenished by rain. The Biscayne Aquifer is South Florida's primary source of fresh or drinking water. Deeper down is the Floridan Aquifer, separated by the confining layer of dense rock. The Floridan Aquifer spans the state and is usually too salty to drink without further treatment.

NOTE: The water control structures in the photos are representative of the many types of structures used by all three systems to convey water. Illustration not to scale.

June 2010


Orlando
Tampa
Indian River
Lake Kissimmee
Kissimmee River
Lake Okeechobee
Caloosahatchee River
West Palm Beach
Sanibel Island
Ft. Myers
Ft. Lauderdale
Gulf of Mexico
Miami
Biscayne Bay
Greater Everglades Ecosystem
Florida & State Protected Lands & Waters
Marjory Stoneman Douglas "River of Grass"
Florida Bay
Key West


CURRENT EVERGLADES WATER FLOW



TAMPA
9,200
$5.6 billion

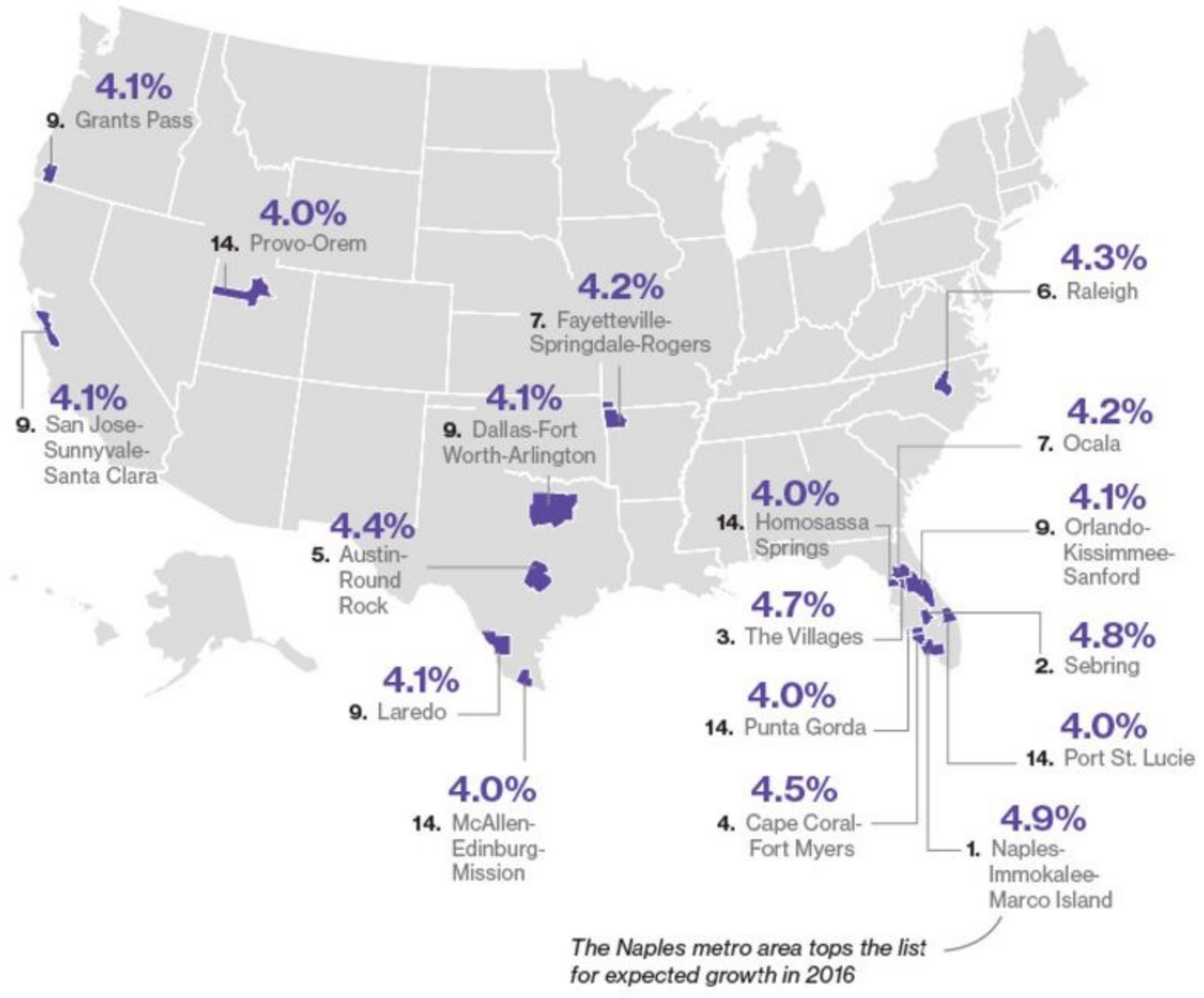
ST. PETERSBURG
28,400
$7.6 billion

Land below high-tide line with five-foot sea-level rise

CAPE CORAL
9,900
$4.2 billion

These Are the New Hubs of Economic Growth

Florida dominates the ranks of the 18 metropolitan areas that will see the most economic growth next year

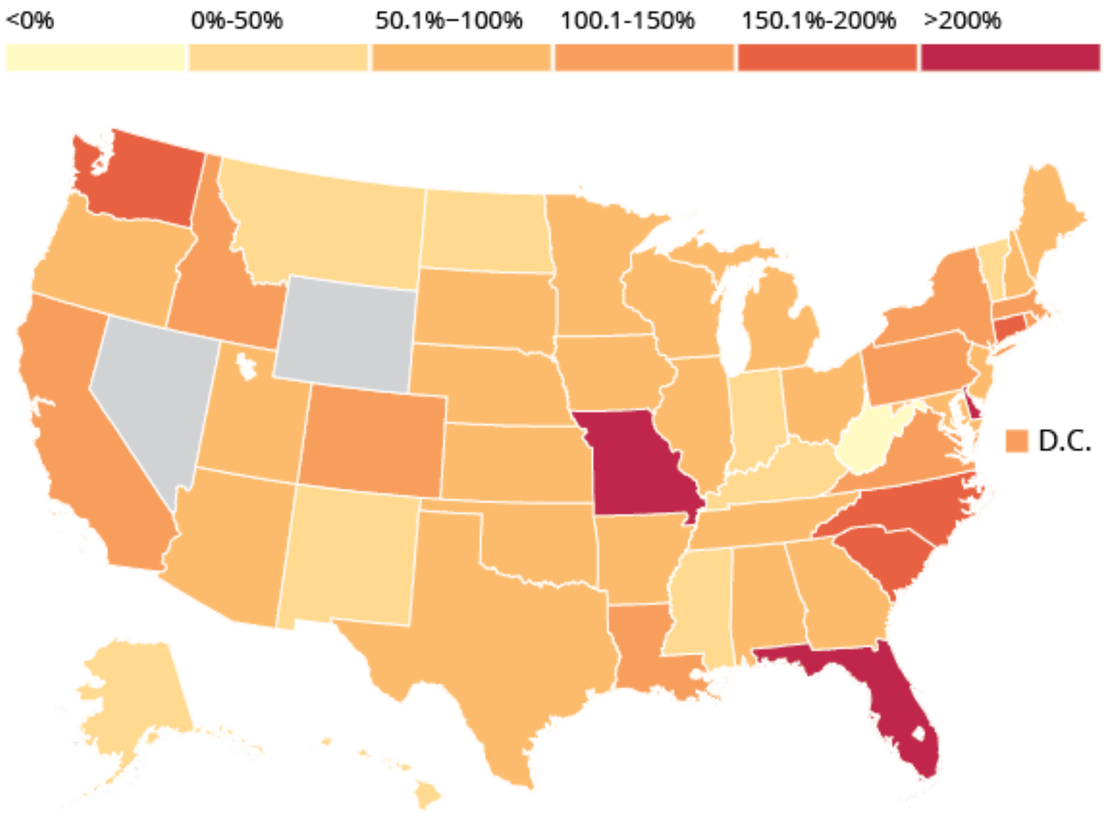


Source: U.S. Conference of Mayors with IHS Global Insight

Where The 1 Percent Captured The Most Income Growth

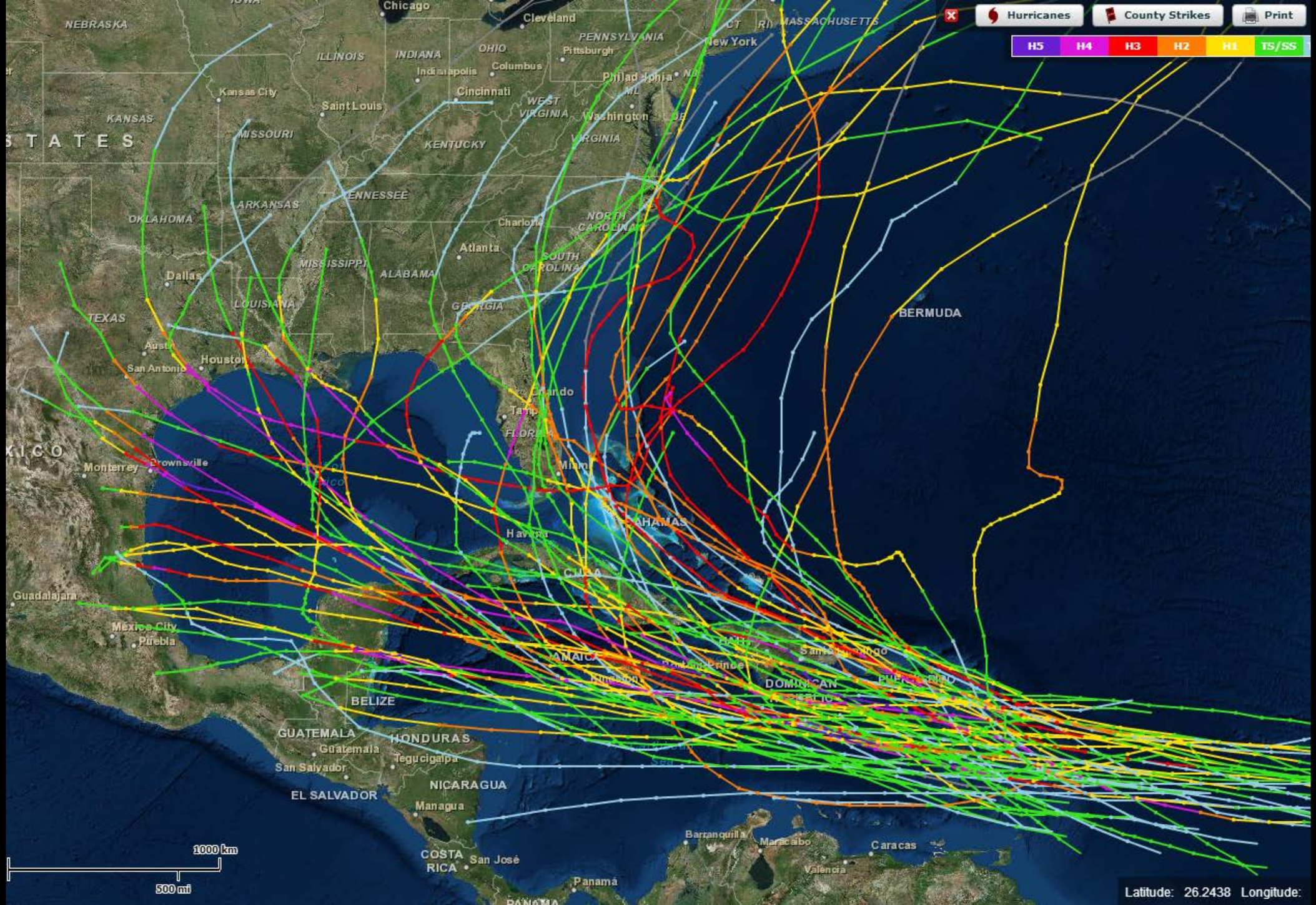
All incomes fell during the Recession. During the first three years of the recovery, income gains for the top 1 percent of earners have far outpaced incomes for the bottom 99 percent. This map shows where the largest percentage of total income growth went to the highest earners.

Share of total growth (or loss) captured by top 1 percent, 2009–2012



Note: Only estimates of top incomes are currently available for Wyoming in 2012. In Nevada, overall income declined even as top 1% incomes grew over this period.
Source: Economic Policy Institute

THE HUFFINGTON POST


Hurricanes
County Strikes
Print
H5
H4
H3
H2
H1
TS/SS
Chicago
Cleveland
NEBRASKA
ILLINOIS
INDIANA
OHIO
Pittsburgh
PENNSYLVANIA
New York
MASSACHUSETTS
Indianapolis
Columbus
Philadelphia
Kansas City
Saint Louis
Cincinnati
WEST VIRGINIA
Washington
KANSAS
MISSOURI
KENTUCKY
VIRGINIA
TENNESSEE
ARKANSAS
OKLAHOMA
Charlotte
NORTH CAROLINA
Atlanta
SOUTH CAROLINA
MISSISSIPPI
ALABAMA
Dallas
LOUISIANA
GEORGIA
TEXAS
BERMUDA
San Antonio
Houston
Orlando
Tampa
FLORIDA
Miami
Monterrey
Brownsville
BAHAMAS
Havana
CUBA
Guadalajara
Mexico City
Puebla
JAMAICA
DOMINICAN
BELIZE
GUATEMALA
HONDURAS
Guatemala
Tegucigalpa
San Salvador
NICARAGUA
EL SALVADOR
Managua
Barranquilla
Maracaibo
Caracas
Valencia
COSTA RICA
San José
Panamá
1000 km
500 mi
Latitude: 26.2438 Longitude:


Houston
New Orleans
Jacksonville
Tampa
Miami
Nassau
BAHAMA
Gulf of Mexico
Havana
CUBA
Cancun
Bay of
KATC
HURRICANE MICHAEL
ADVISORY TIME: 10:00 AM
WINDS: 110 mph
GUSTS: 130 mph
LOCATION: 25.0°N 86.2°W
MOVEMENT: N at 12 mph
PRESSURE: 965 mb 28.50"
Thu 8:00AM 50 mph
Wed 7:00PM 85 mph
Wed 8:00AM 125 mph
Tue 8:00PM 120 mph
Chicago
Omaha
Denver
Memphis
Dallas
Houston
Lafayette
Jacksonville
Miami
BAHAMAS
CNN

Among the Ruins of Mexico Beach Stands One House, Built 'for the Big One'

By Patricia Mazzei

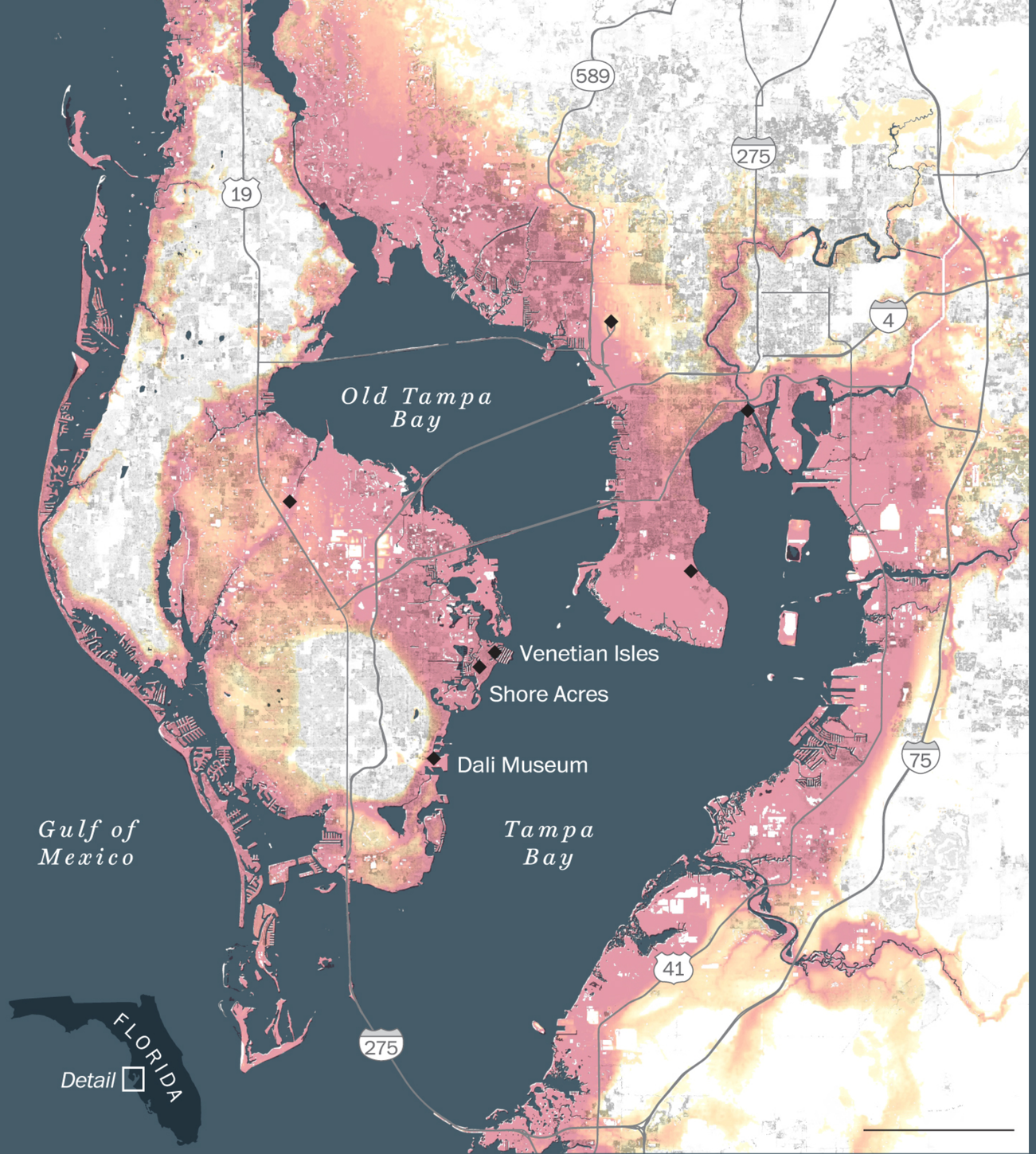
Oct. 14, 2018

A group of scientists just presented updated sea level rise projections to Tampa Bay politicians. Here's what they say.

A group of scientists just presented updated sea level rise projections to Tampa Bay politicians. Here's what they say.

Their projections are 12 to 18 inches higher than the same group's 2015 estimates on average.

Beachfront areas like Redington Beach could face sea level rise of anywhere from 2 to 8 feet by the end of the century, according to the latest projections. [Luis Santana | Times]


589
275
19
4
Old Tampa Bay
Venetian Isles
Shore Acres
Dali Museum
75
Gulf of Mexico
Tampa Bay
41
275
FLORIDA
Detail

VERZILTING

Deze droogte is een live **stresstest**

De maatregelen die Nederland nam om de schade van de droogte te beperken, waren verstandig. Maar hoe zal dat in de toekomst gaan?

Door onze redacteur
Arjen Schreuder

AMSTERDAM. De droogte was hevig, heeft vele records gebroken en houdt aan, ook al heeft het deze week eindelijk geregend. „Met één buitje gaan we het niet redden", vertelde directeur-generaal Michèle Blom van Rijkswaterstaat woensdag in een twitterfilmpje. „We hebben twee tot drie maanden typisch Nederlands weer nodig om de voorraad weer aan te vullen."

Hebben we de droogte goed doorstaan? Heeft Nederland de juiste maatregelen genomen? Is de schade niet onnodig groot geweest? En kunnen we er iets van leren, voor vergelijkbare zomers die volgens klimaatwetenschappers ongetwijfeld komen? „Deze droogte is een live stresstest", zegt deltacommissaris Wim Kuijken. Hij voert namens de regering de regie over het programma voor de komende decennia om Nederland te beveiligen tegen te veel én ook tegen te weinig water.

Wat Kuijken betreft hebben de watermanagers de test goed doorstaan. „Ik herinner me het recordjaar 1976 nog heel goed. Toen werd Nederland verrast door de droogte. Er moesten toen hals over kop waterlopen worden verlegd. Zulke maatregelen waren nu niet nodig."

De boeren hebben het zwaar. Veel particuliere tuintjes zijn naar de knoppen. Beken zijn drooggevallen, de natuur heeft een tik gekregen. Maar er zijn geen uitgedroogde veendijken bezweken, zoals in 2003 in Wilnis. De drinkwatervoorziening is geen moment in gevaar geweest. De verzilting van het water in het westen, met z'n bolgewassen en bomenteelt, blijft beperkt door onder meer de aanvoer van extra water uit het Amsterdam-Rijnkanaal. „De maatregelen waren verstandig en goed gecoördineerd", zegt Huub Savenije, emeritus hoogleraar hydrologie aan de TU Delft. „Daar valt niets op aan te merken."

Toch geeft het relatieve succes van de maatregelen te denken. Kan Nederland hevige droogte ook in de toekomst aan? Moeten we geen drastische maatregelen nemen? Spoort de inrichting van Nederland nog met de natuur?

Om te beginnen zijn we door de droogte weer met de neus op de feiten gedrukt; we gebruiken ontzettend veel rivierwater om het zilte water uit zee buiten de deur te houden. Dat water zijn we 's winters liever kwijt dan rijk, maar 's zomers, bij een tekort, hadden we het goed kunnen gebruiken voor andere dingen. „We verkeren in een luxe positie met al dat rivierwater. Nederland is 36.000 vierkante kilometer groot en krijgt via de Rijn water uit een stroomgebied van 185.000 vierkante kilometer. Daarmee hebben we een ontzettend groot voordeel ten opzichte van andere Europese landen", zegt Frans Klijn, rivierdeskundige bij kennisinstituut Deltares. Het zou wel mooi zijn het overtollige rivierwater uit de winter te sparen voor de droge zomers. „Dat is de opgave voor de toekomst."

Mammoettanker

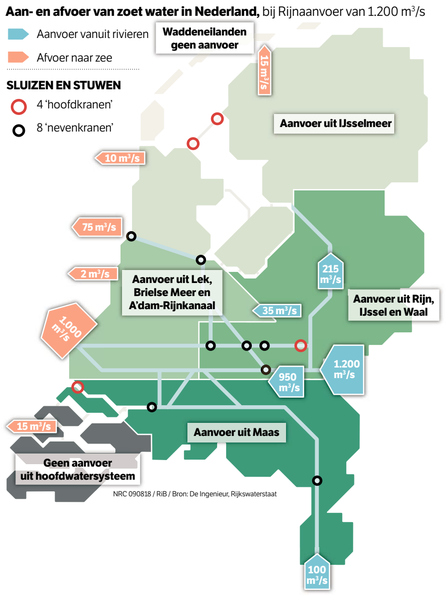
Water 'vasthouden' is het devies. In natte natuurgebieden bijvoorbeeld. In vijvers in steden. Op boerenland. En nadenken of je de koers van de „mammoettanker" niet nu al moet wijzigen, om te voorkomen dat ons watermanagement over enkele tientallen jaren stagneert. Frans Klijn: „Met ons huidige systeem kunnen we het nog lang volhouden. Maar het is als bij het gas; als je er lang van afhankelijk bent, kom je er moeilijk los van. Het risico bestaat dat we onszelf in een groef hebben gemanoeuvreerd waar we niet meer uitkomen."

De verzilting treedt niet alleen op door droogte, maar wordt ook heviger door zeespiegelstijging. Het is denkbaar dat de zee over honderd jaar een meter hoger ligt. Dan krijg je problemen met het inlaten van zoet water. We zouden veel minder rivierwater nodig hebben door het verzilte water al eerder tegen te houden. Je zou nieuwe keringen of sluizen kunnen bouwen, zoals in de Hollandse IJssel, waar brak water indringt, of zelfs in de Nieuwe Waterweg bij Rotterdam. Dat is duur, en bovendien onwenselijk voor de Rotterdamse haven. „Al kun je je voorstellen dat de haven op lange termijn buitengaats komt te liggen, en schepen de Waterweg niet meer op hoeven", zegt emeritus hoogleraar Huub Savenije. Maar het is nog niet nodig, denkt deltacommissaris Kuijken. „We hebben nu de kleinschalige wateraanvoer om water van oost naar west te brengen. Dat systeem gaan we komende jaren uitbreiden. Dat is veel goedkoper dan het afsluiten van de Waterweg."

Een andere mogelijke maatregel tegen de droogte is het bijvullen van de nationale waterton, het IJsselmeer. Geen gek idee als je bedenkt dat er tijdens de droogte meer water uit het IJsselmeer verdampt en er wordt uitgehaald dan er via de IJssel weer in stroomt. Onlangs is besloten dat het peil 's zomers enkele tientallen centimeters mag fluctueren al naar gelang de behoefte aan zoet water.

Maar je zou het drastischer kunnen aanpakken, zoals het peil structureel met an-

Zoetwaterinfuus



Droogte versus regen bij Vogelenzang (boven) en de Amsterdamse Waterleidingduinen.

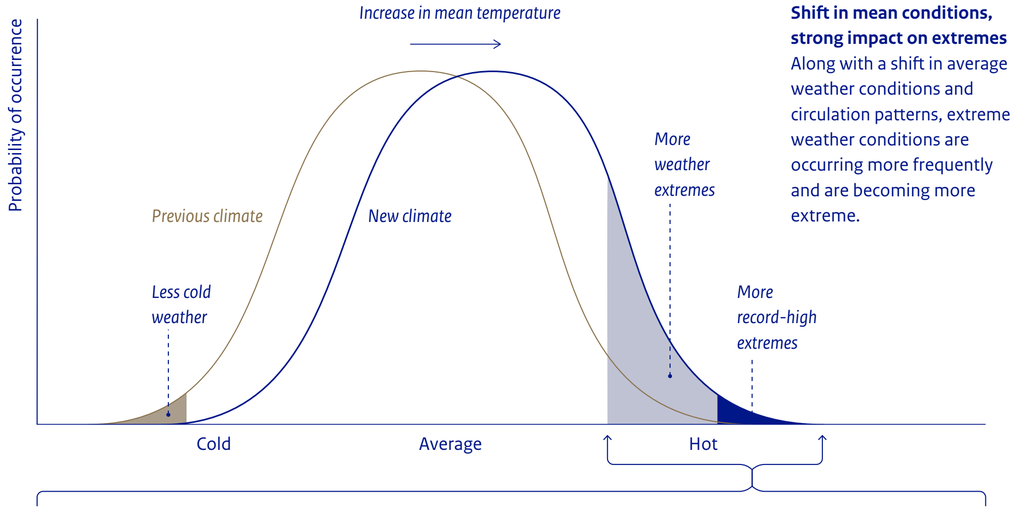
FOTO OLIVIER MIDDENDORP

understand

CLIMATE CHANGE AND WEATHER EXTREMES

Climate change involves both slow and gradual changes, such as in temperature, precipitation patterns and sea level rise, as well as changes in weather extremes, such as drought, flooding and storm surges.

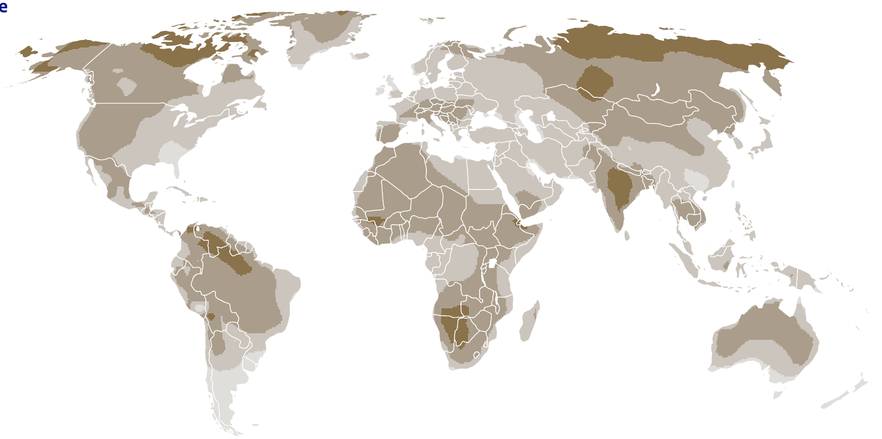
Society is primarily impacted by climate change through changes in the global and local water system. Changes in precipitation patterns, weather extremes, water-related disasters, sea level rise, and melting sea ice affect both security risks and development opportunities. The warming of rivers, lakes, seas and oceans negatively affects the quality of their ecosystems.



Shift in mean conditions, strong impact on extremes
Along with a shift in average weather conditions and circulation patterns, extreme weather conditions are occurring more frequently and are becoming more extreme.

Temperature extremes
Storm surges
Coastal flooding
Precipitation extremes
Drought
River flooding

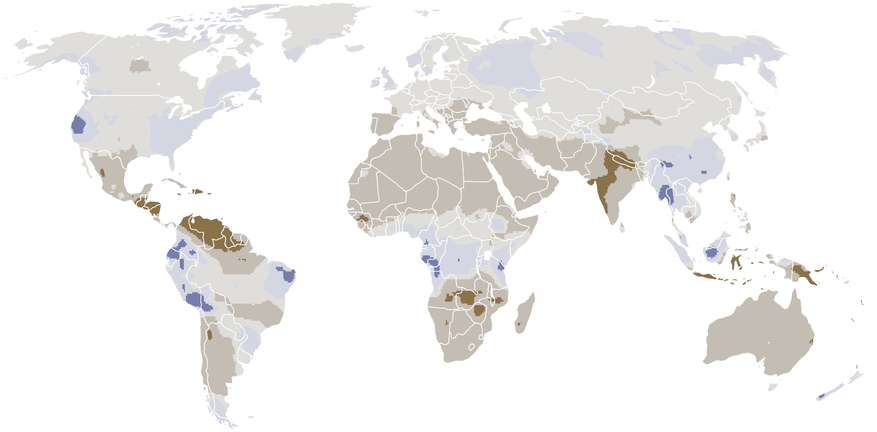
Change in temperature 2010–2050
Global average temperature is projected to increase by around 2 °C by 2050, with large regional differences. The northern regions face relatively high temperature increases.



°C
0.3 – 1
1.1 – 1.5
1.5 – 2
> 2

Source: PBL

Change in net precipitation 2010–2050
In general, the net result of changing temperature, precipitation patterns and evaporation is that most dry areas will become dryer and wet areas wetter.



mm/day
< -0.5
-0.5 – -0.1
-0.1 – 0.1
0.1 – 0.5
> 0.5

Source: PBL

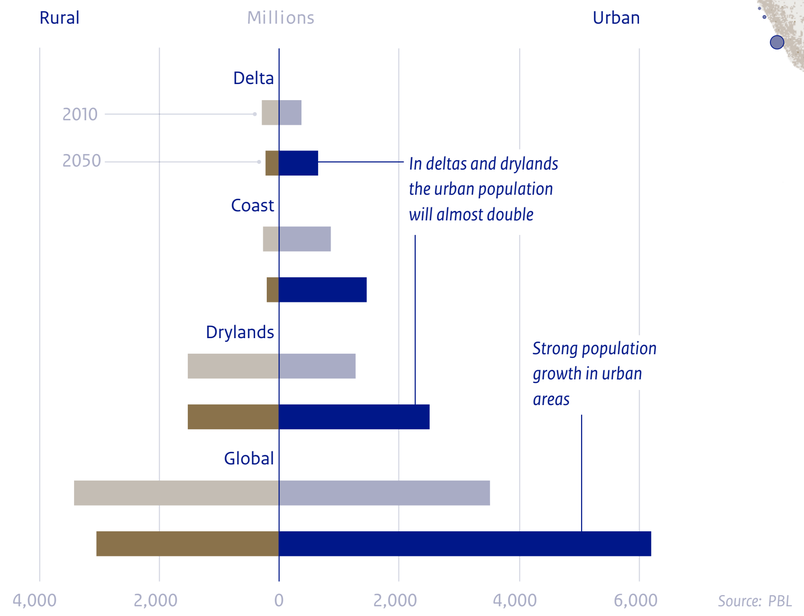
URBANISATION CHANGES GLOBAL VULNERABILITY

Because of continued global urbanisation, water-related risks will increasingly be concentrated in cities.

In the urbanising world, cities will increasingly become centres of population growth and economic development. By 2050, 70% of the world population is projected to live in an urban environment, and the 600 major cities in the world are expected to provide 60% of global GDP. The global urban area is expected to expand by more than 70%, not only in riparian and coastal areas and in deltas, but also in water-stressed regions, such as drylands. By 2050, 70% of the global population will be living on 0.5% of the global land area.

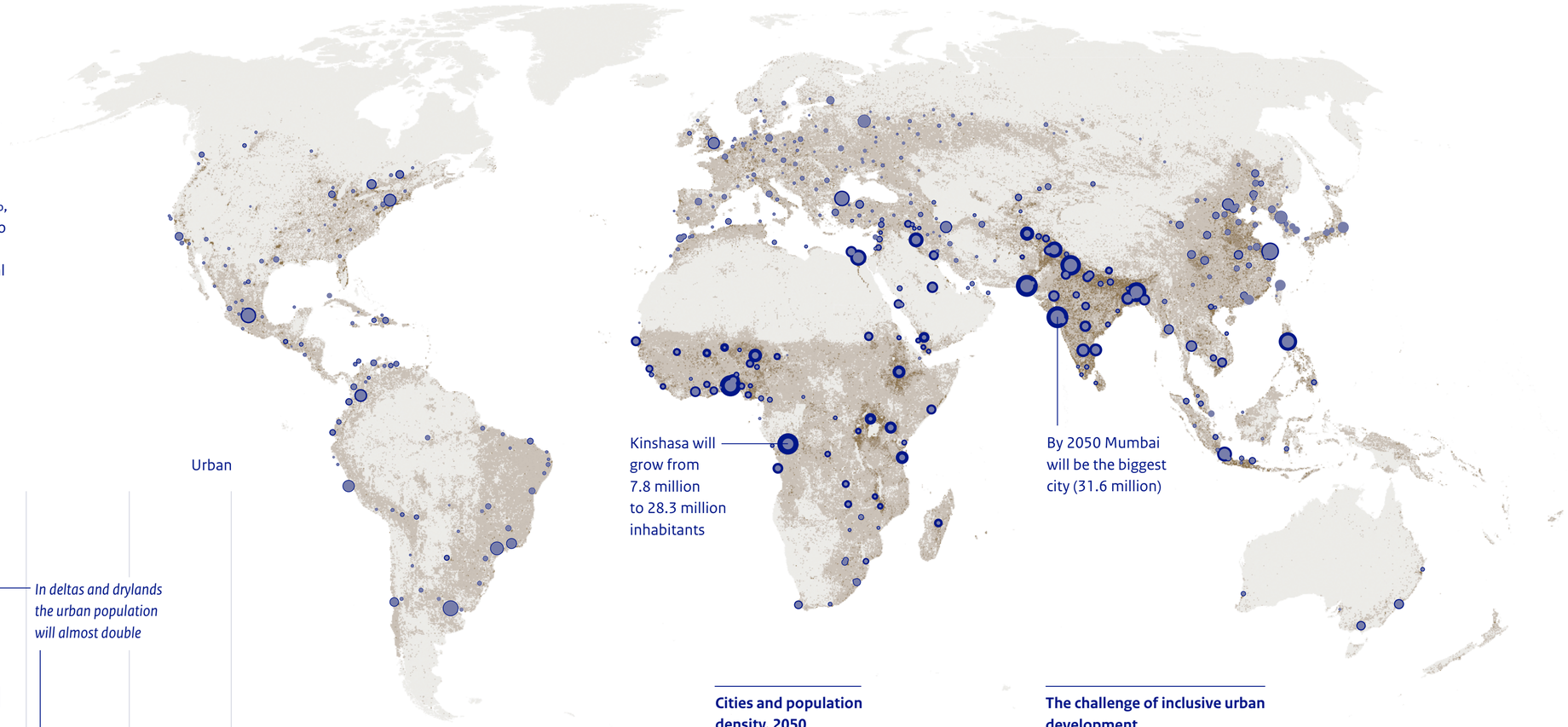
Change in urban and rural populations, per type of area, 2010–2050

Fast urban growth, more than doubling city sizes, occurs especially in the developing countries of East and South Asia and Sub-Saharan Africa.



Source: PBL

Cities Flood Risk Hotspots



Cities and population density, 2050

Cities 2010
Cities 2050

Inhabitants (millions)
10
20
30

Population density (number of people per 30'' grid cell)
1–100
101–500
501–1,000
>1,000

Source: PBL

The challenge of inclusive urban development

Today, about one billion people are living in urban slums. The rapidly growing urban population strongly increases the pressure on local resources, local environmental conditions, food availability, labour opportunities, and public services. Reducing inequality, insecurity and poverty in cities may be some of the major challenges, on the path towards 2050.

global flood losses coastal cities will tenfold in 2050 US$52 billion / year
all losses global flood damage will cost US$1 trillion a year (OECD / WB)

LOSSES IN 2050 IF AN EXTREME WEATHER EVENT OVERWHELMS SEA-LEVEL-RISE DEFENSES OF URBAN AREAS*

- More than $140 billion
- $70 billion to $140 billion
- $35 billion to $70 billion
- $17.5 billion to $35 billion
- Less than $17.5 billion

POPULATION DENSITY, 2013

High — Low

*ASSUMES CITIES CONTINUE TO BUILD PROTECTIONS ON PACE WITH SEA-LEVEL RISE TO MAINTAIN A CONSTANT RELATIVE RISK OF FLOODING (IN 2005 U.S. DOLLARS)

SOURCE: STEPHANE HALLEGATTE, ET. AL., *NATURE CLIMATE CHANGE*, SEPTEMBER 2013

TOP 10 COASTAL URBAN AREAS

Miami	$278 billion
Guangzhou	268
New York-Newark	209
New Orleans	191
Hong Kong	140
Mumbai (Bombay)	132
Osaka-Kobe	108
Shanghai	100
Amsterdam	96
Ho Chi Minh City	95

Rotterdam is #12 $ 82 B

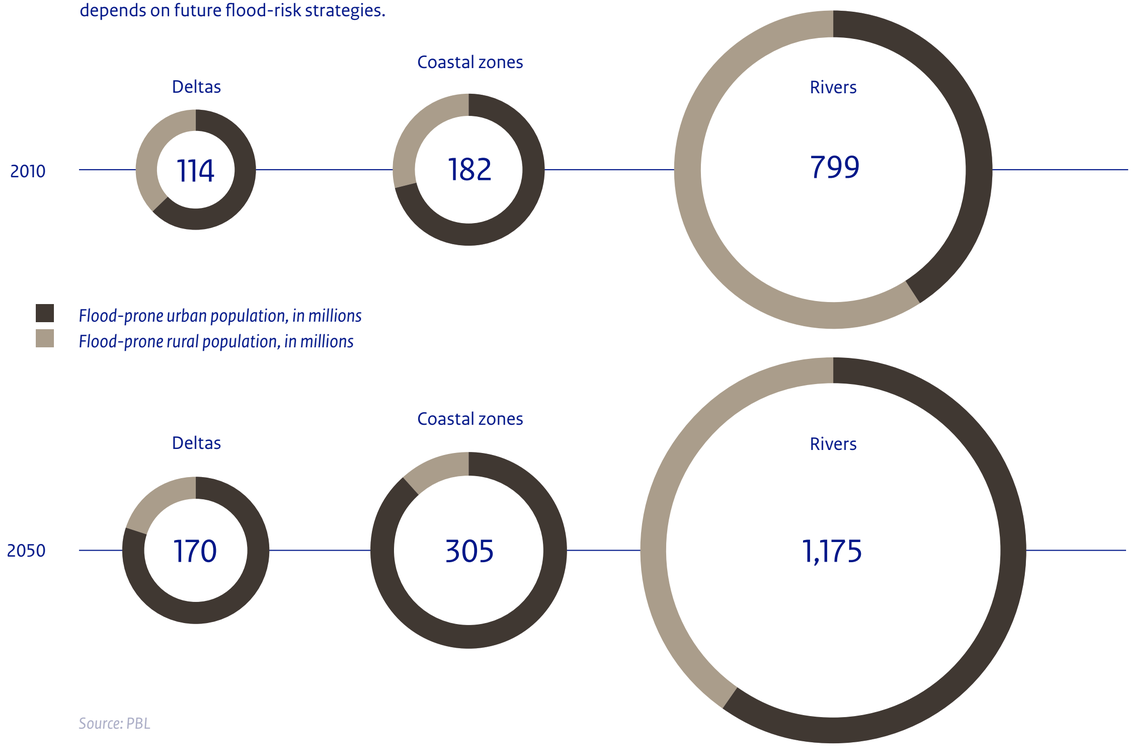
NATIONAL GEOGRAPHIC

UNEQUAL FLOOD RISKS WITHIN CITIES

The number of people in flood-prone areas in the developing world is expanding rapidly. Without attention, flood protection inequality between urban formal and informal settlements will increase.

Global population growth will concentrate in cities
Globally, the population is increasingly concentrated in cities, most of which are located near rivers or the coast. This trend is projected to continue, between now and 2050. How flood risks and protection of formal and informal settlements will develop, depends on future flood-risk strategies.

Most people potentially exposed to flooding live in cities along rivers.

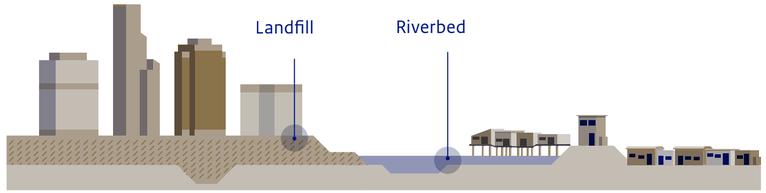


Source: PBL

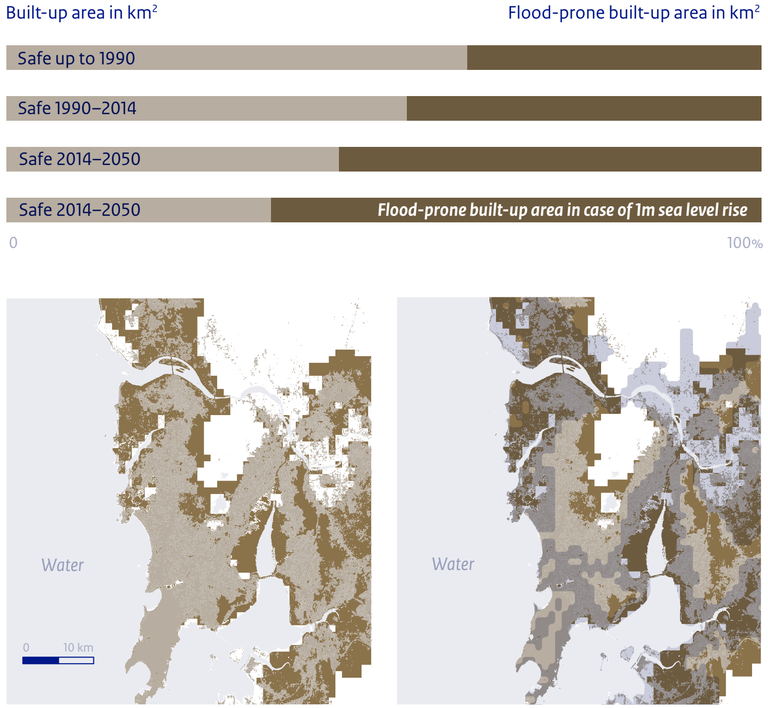
Informal settlements are the most exposed
In many cities, especially in developing countries, the inhabitants of informal settlements make up more than 50% of the urban population. Water- and climate-related disasters disproportionately affect people living in informal settlements.

Formal settlement
Built on landfill

Informal settlement
Built directly on the riverbed



Built-up and flood-prone areas in Mumbai
From 1990 to 2014, the built-up area of Mumbai expanded by 26%, with a relatively large share of the expansion in flood-prone areas. This trend is projected to continue towards 2050, by which time around 60% of Mumbai will be located in flood-prone areas.
If sea levels would rise by one metre, the flood-prone area would become even larger and the number of people potentially exposed would increase further.



Built-up, up to 2014
2014–2050
Flood-prone area, 2050

Source: JRC, PBL

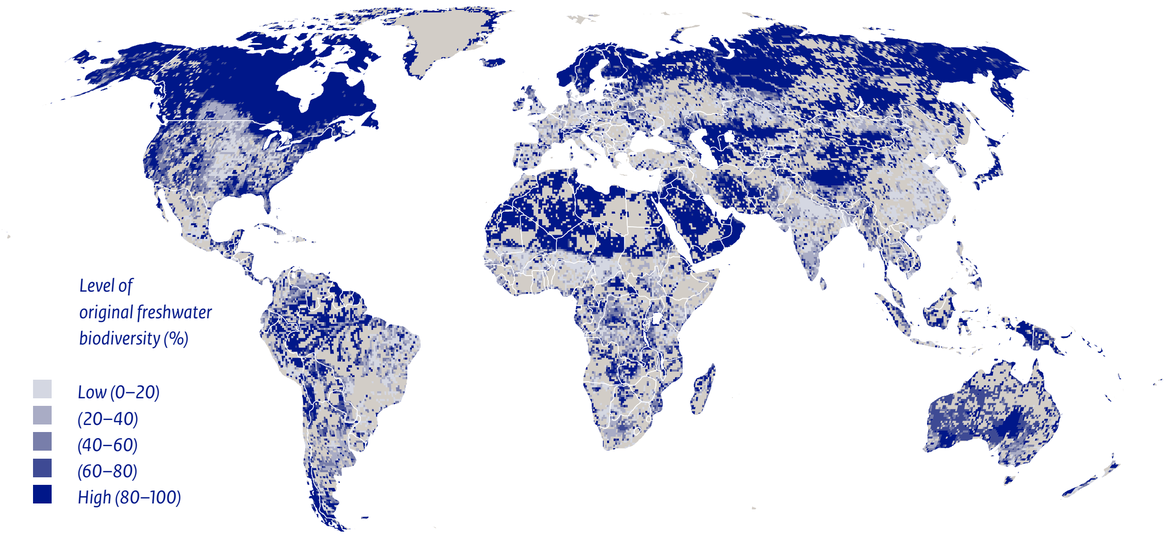
FURTHER BIODIVERSITY LOSS TOWARDS 2050

Under the Business-as-usual scenario, developments will result in further biodiversity loss in nearly 40% of the world's freshwater ecosystems.

Decrease in freshwater ecosystems with high levels of biodiversity
Tropical regions include the most biodiverse river basins. High-quality ecosystems in these regions, however, are already severely affected and will further decline in quality, between now and 2050. The strongest decline in quality is projected for Sub-Saharan Africa and parts of Latin America and Asia. In developed regions, such as Europe, the United States and Japan/Oceania, most of the decline in quality has already occurred. Overall, natural biodiversity will be preserved in less than 60% of the world's aquatic ecosystems, under the Business-as-usual scenario.

Projected quality of freshwater ecosystems, 2050

In the sparsely populated northern regions, the quality of freshwater ecosystems will be least affected.

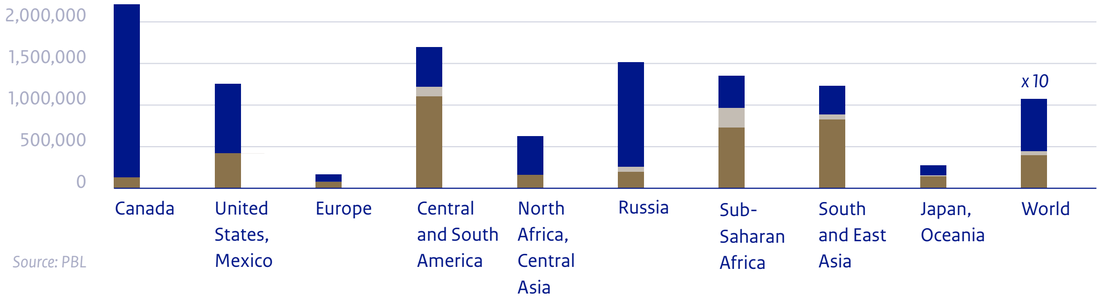


Source: PBL

Decline in freshwater ecosystems with high biodiversity levels *(in 1000 km²)*

Level of loss in 2010 *Loss by 2050* *Remaining in 2050*

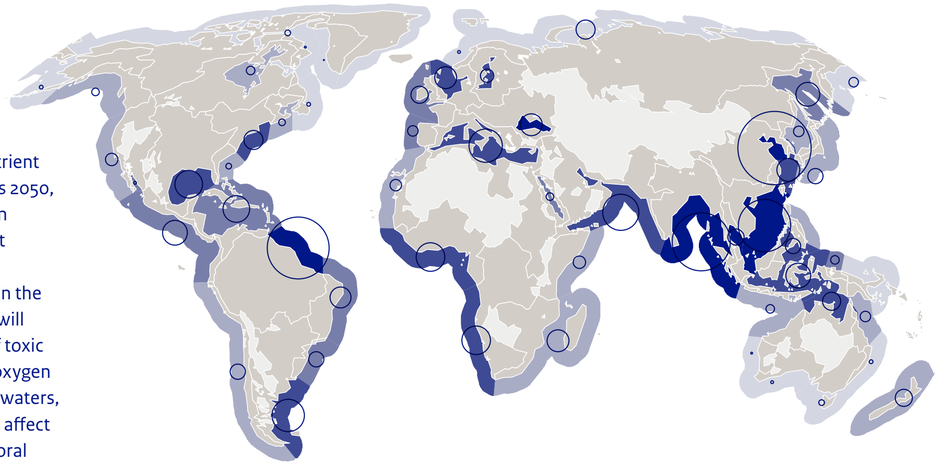
In the coming decades, most losses are expected to occur in the tropical and sub-tropical zones in Sub-Saharan Africa, Latin and Central America and South and East Asia.



Source: PBL

Quality of coastal seas threatened by increased nutrient loading

The increase in nutrient emissions, towards 2050, will also result in an increase in nutrient loading to coastal waters, especially in the Asian region. This will increase the risk of toxic algal blooms and oxygen depletion in those waters, and will negatively affect biodiversity (e.g. coral reefs) and ecosystem functions, such as aqua-culture and fisheries.



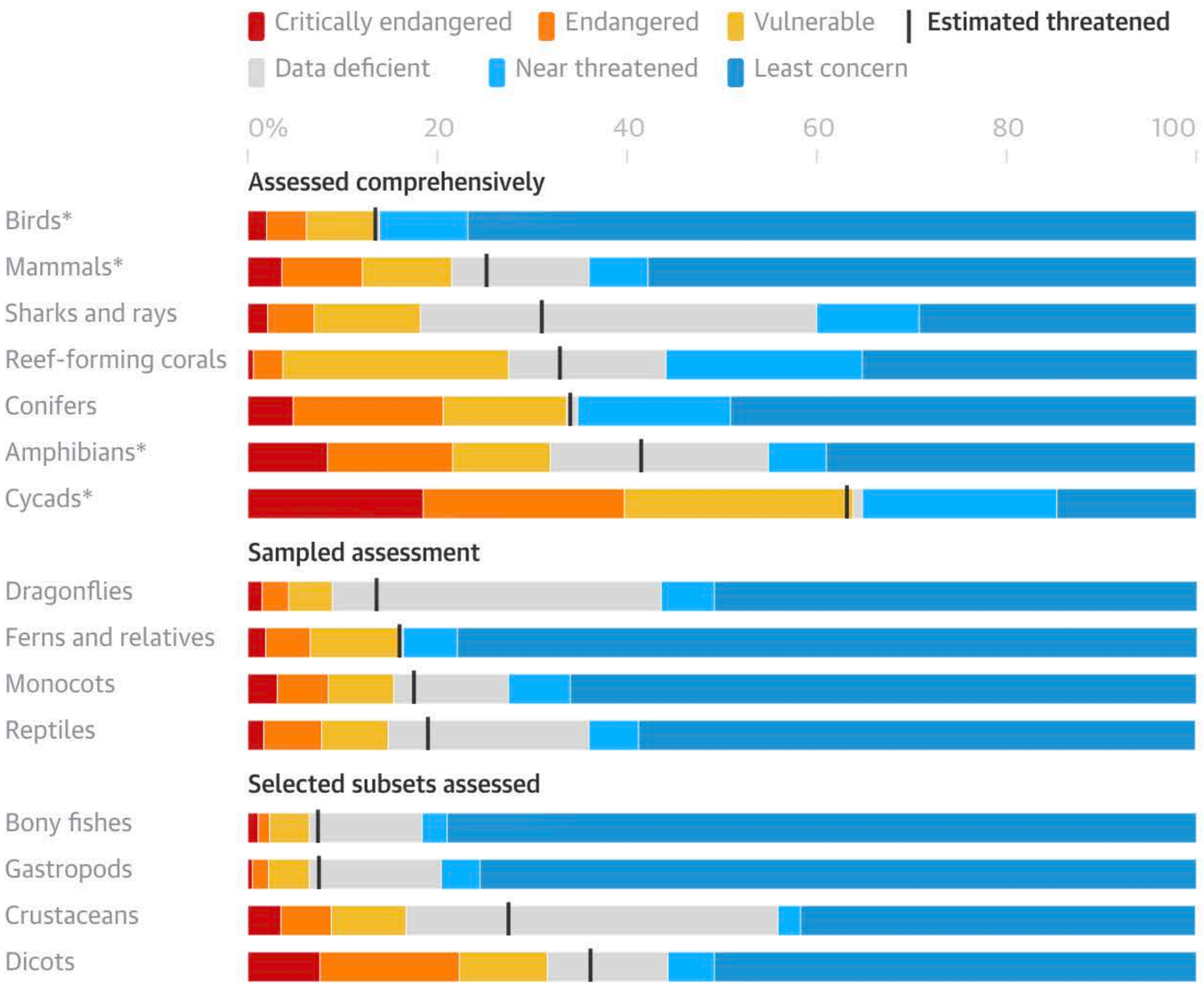
Nutrient loading to coastal seas, 2050
Absolute, x 1000 kg N
1,000,000

Nutrient loading, 2050
Relative
High Low

Catchment
No outflow areas

Source: PBL

The International Union for Conservation of Nature estimates a quarter of mammals and more than two-fifths of amphibians are threatened with extinction



Guardian graphic. Source: IPBES, IUCN red list. *Critically endangered includes extinct in the wild

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Science and Policy for People and Nature

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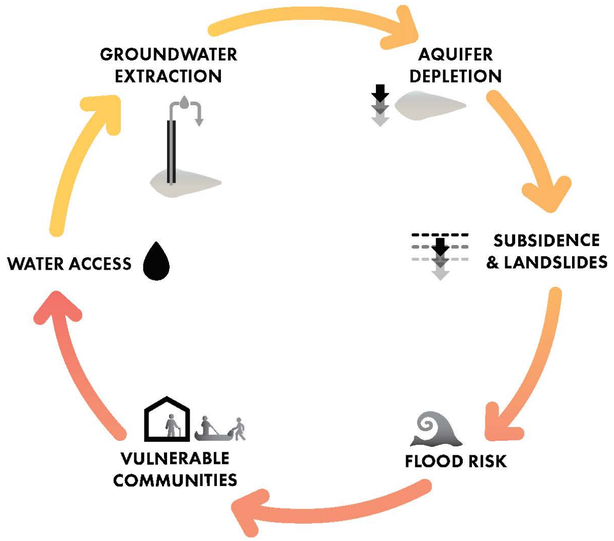
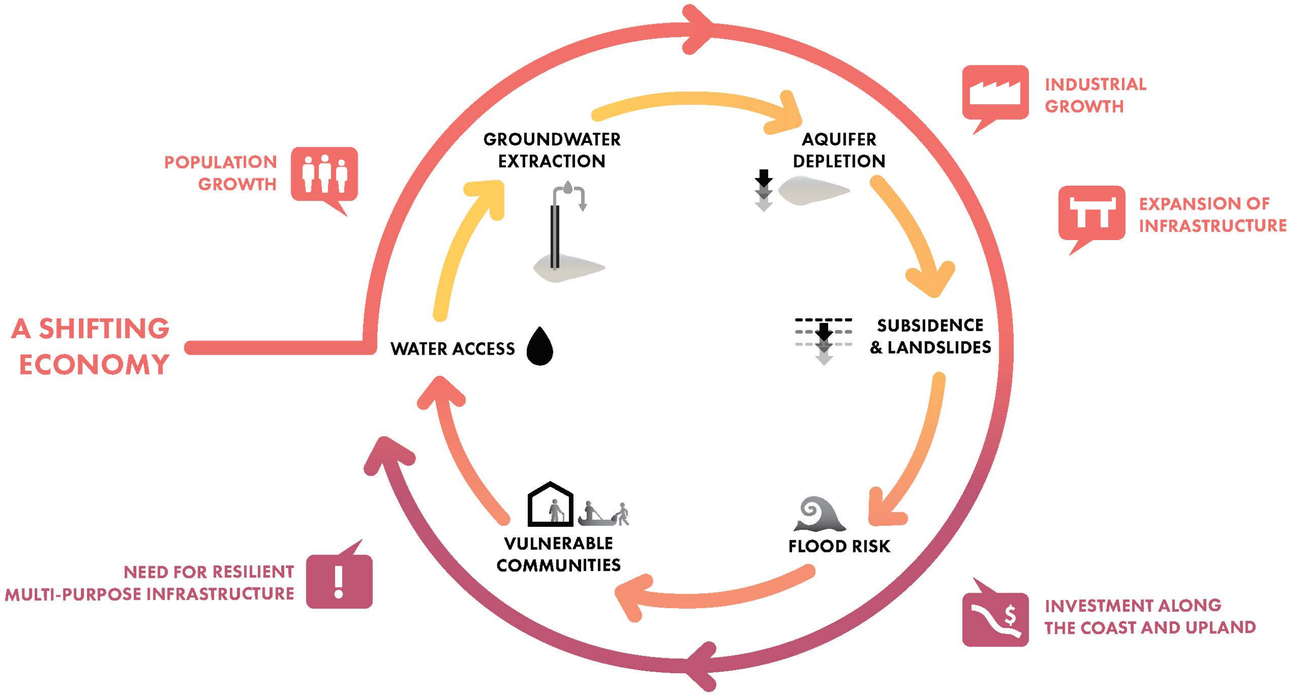
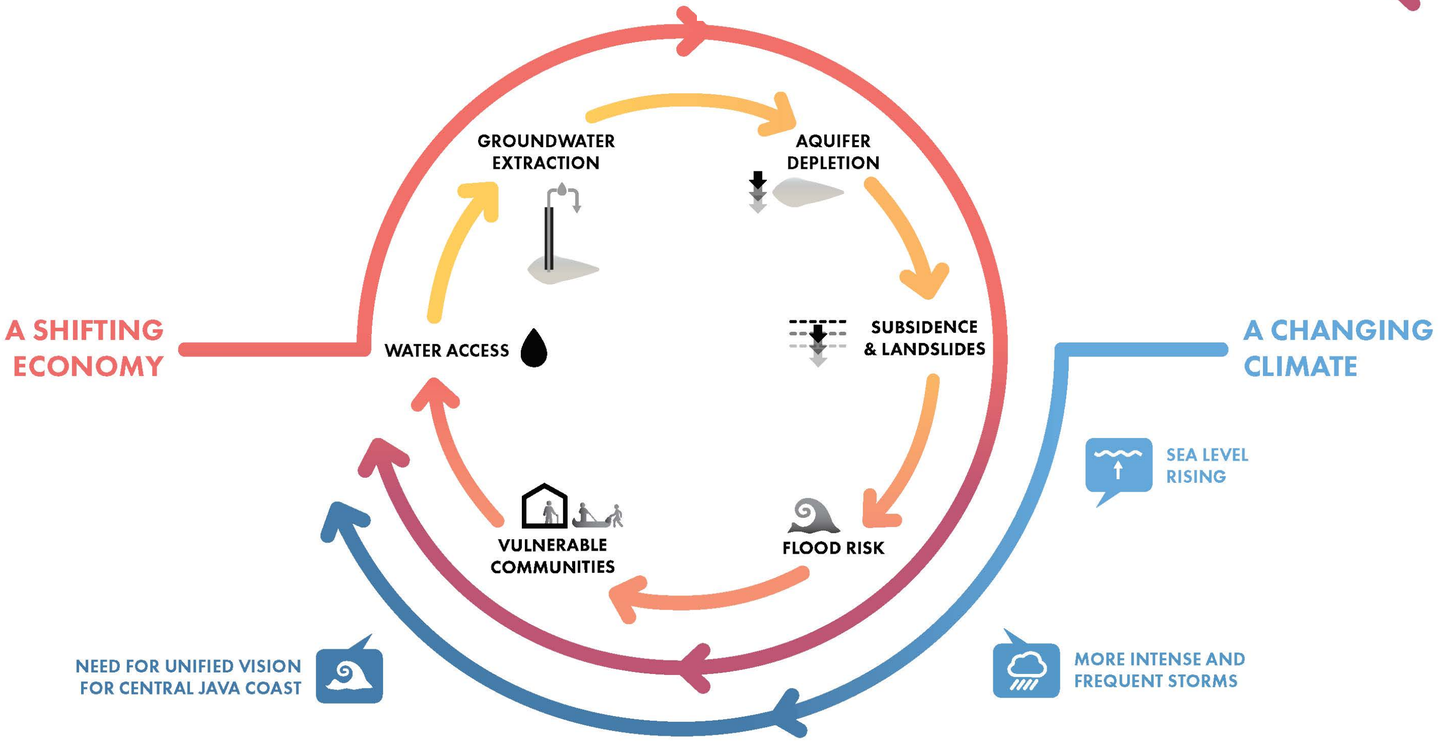
Media Release: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating'



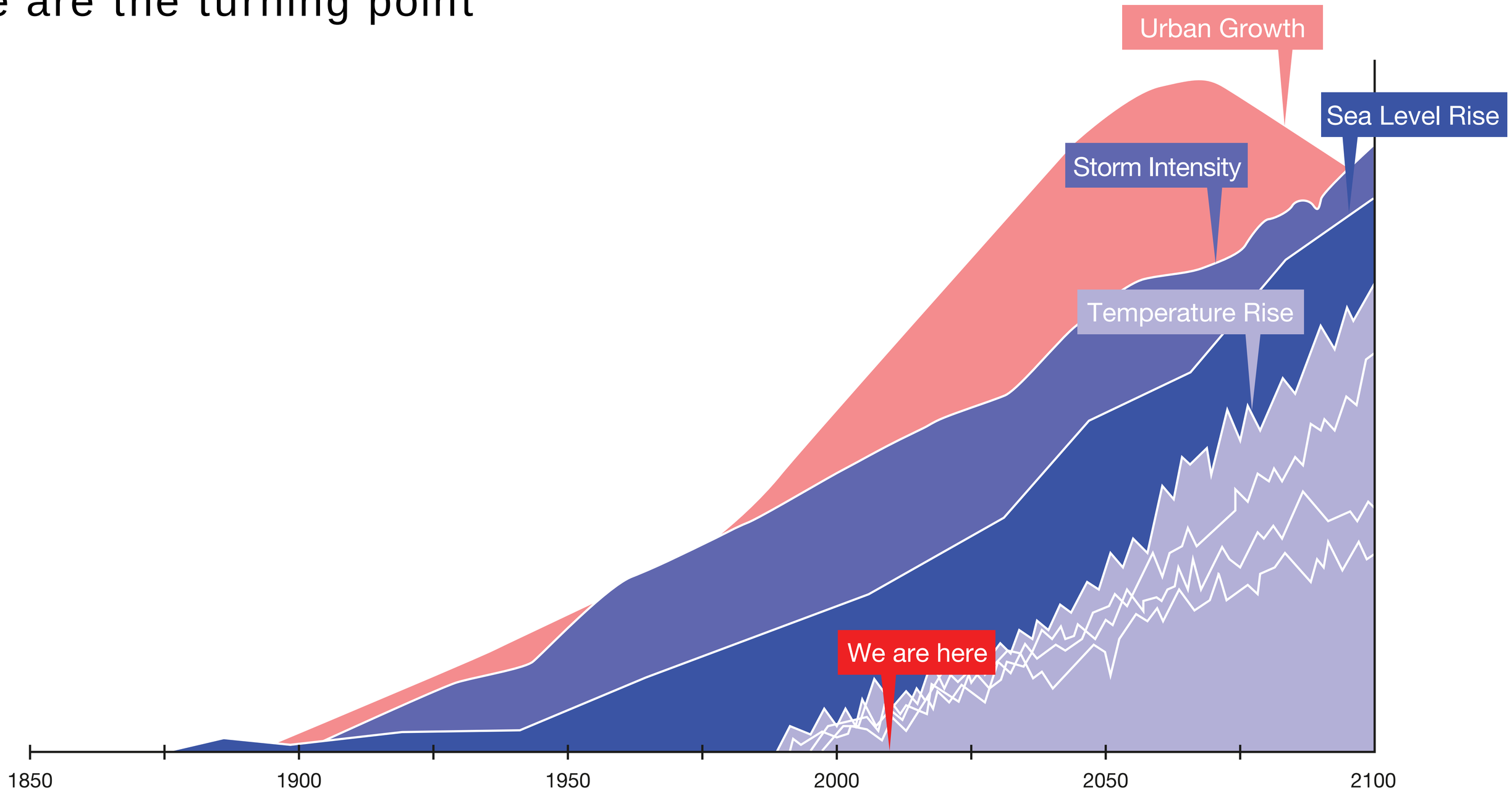




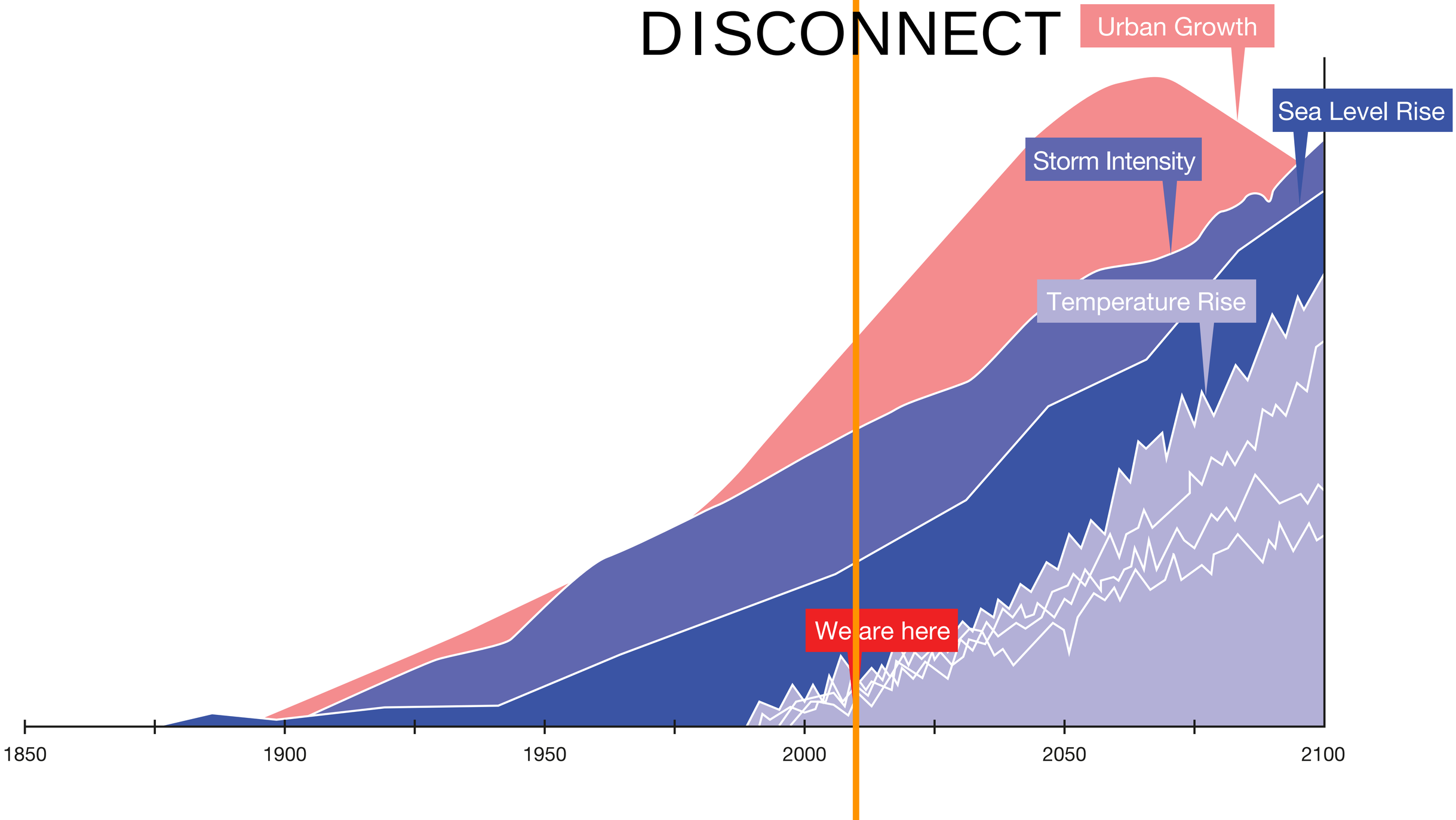
one resilient semarang

Water for
as Resilient Cities
Leverage Asia

We are the turning point

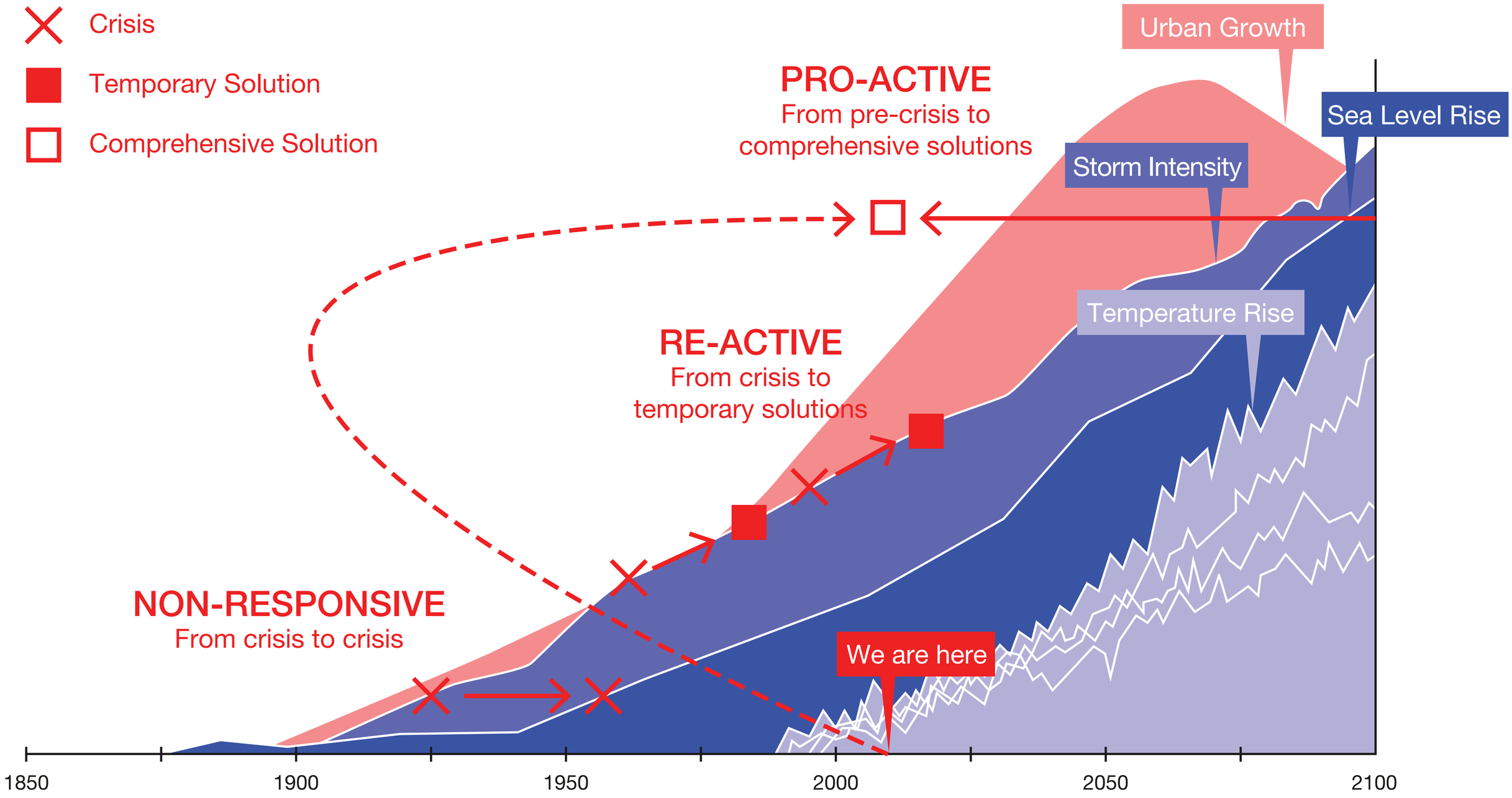


DISCONNECT


Urban Growth
Sea Level Rise
Storm Intensity
Temperature Rise
We are here
1850
1900
1950
2000
2050
2100

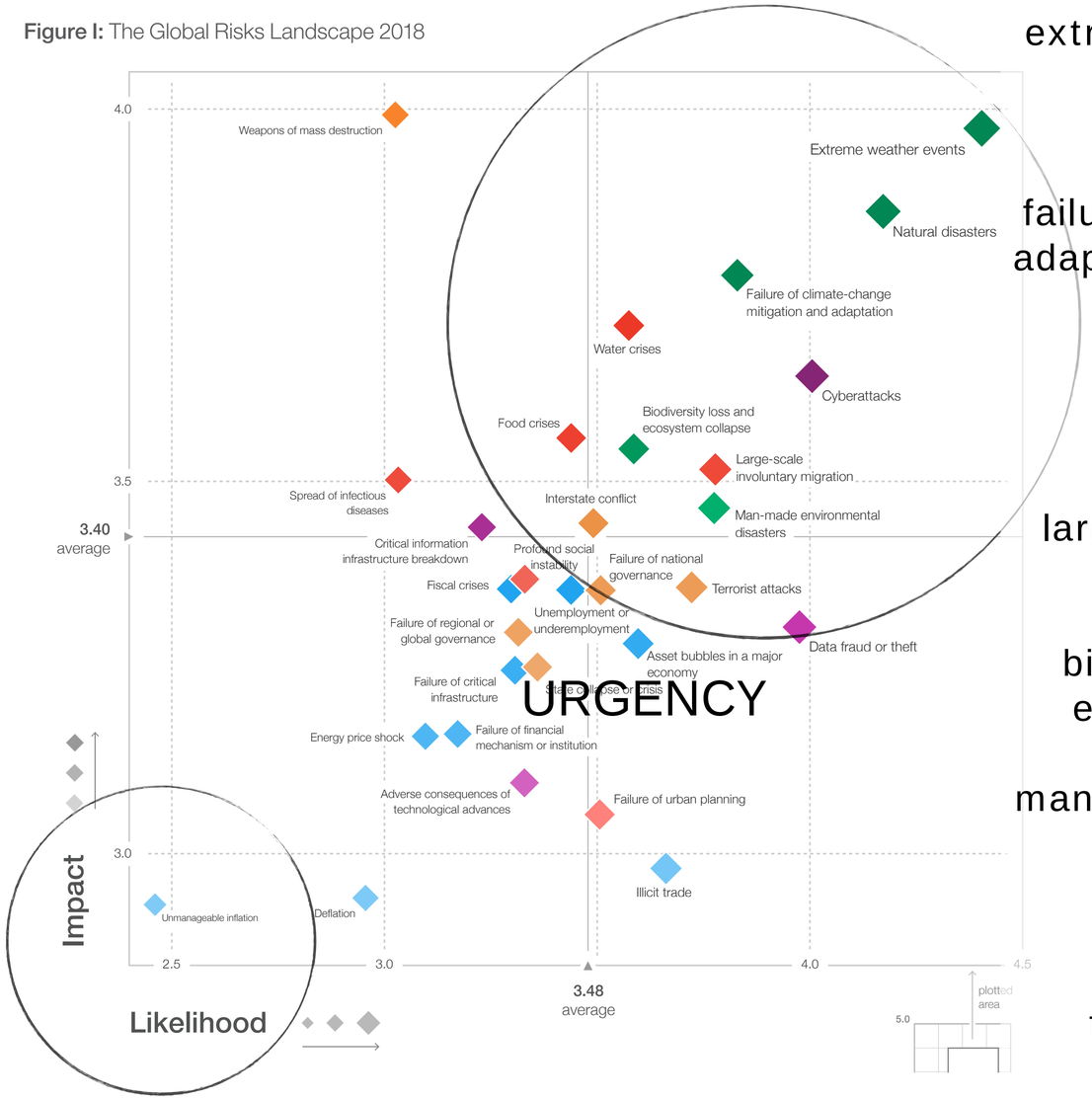
Bridge the gap

business as usual is ~~*not enough*~~ lethal


Crisis
Temporary Solution
Comprehensive Solution
PRO-ACTIVE
From pre-crisis to
comprehensive solutions
RE-ACTIVE
From crisis to
temporary solutions
NON-RESPONSIVE
From crisis to crisis
Urban Growth
Sea Level Rise
Storm Intensity
Temperature Rise
We are here
1850
1900
1950
2000
2050
2100

Risks, uncertainties and opportunities

Figure I: The Global Risks Landscape 2018



extreme weather events

natural disasters

failure of climate change adaptation and mitigation

water crises

cyber attacks

large scale involuntary migration

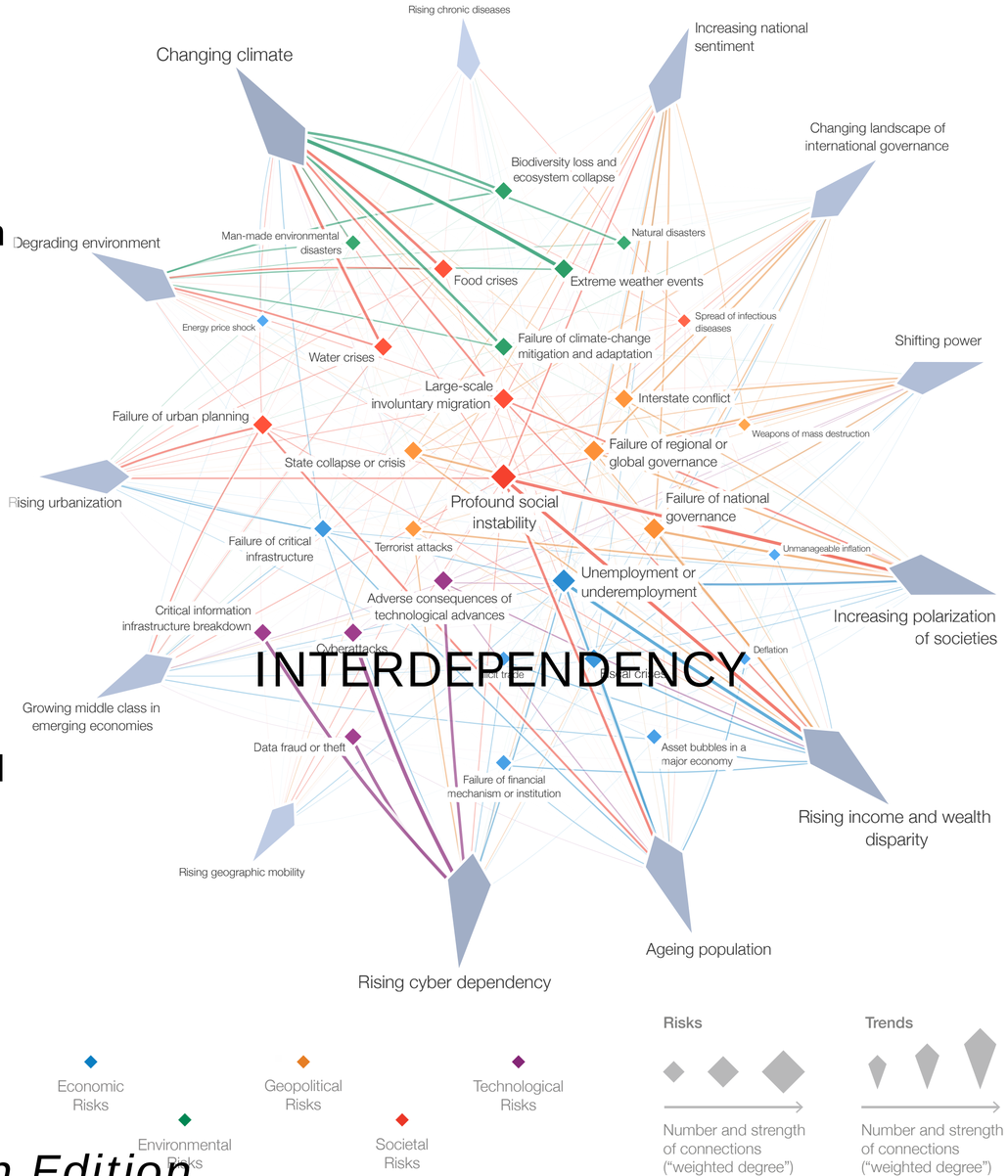
biodiversity loss and ecosystem collapse

man made environmental catastrophes

food crises

failure of national governments

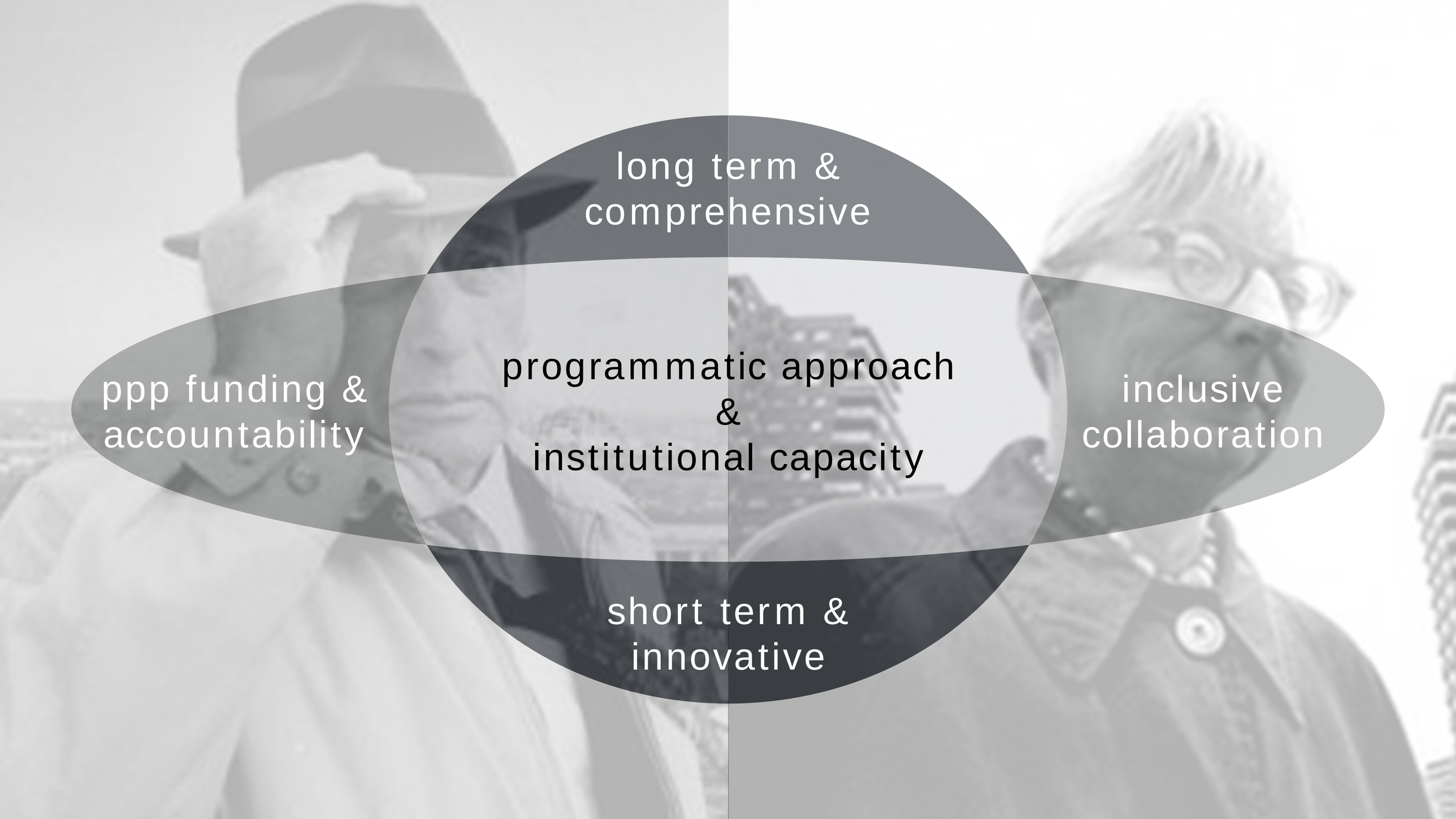
Figure II: The Risks-Trends Interconnections Map 2018

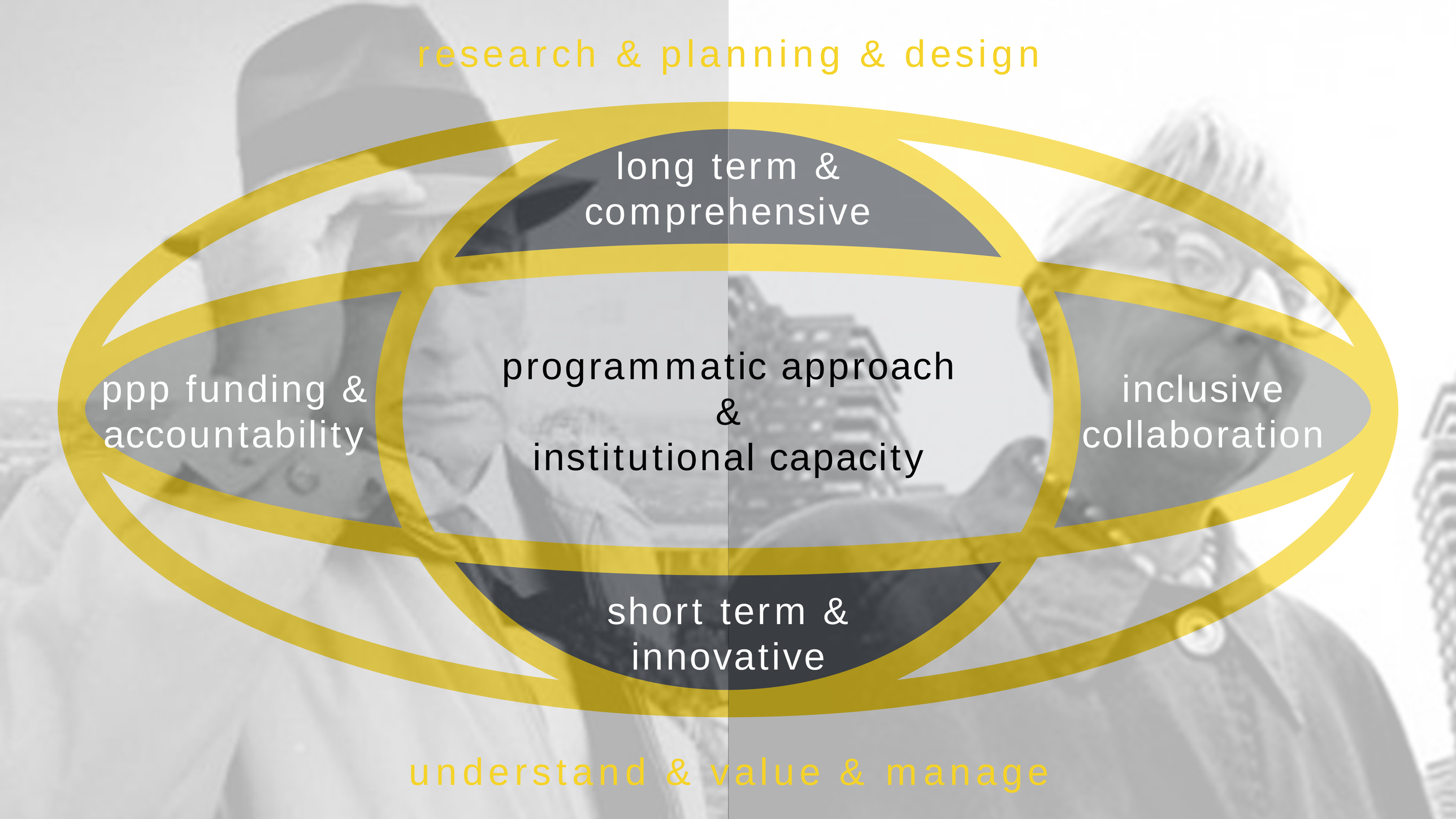


WEF Global Risks 2018, 13th Edition

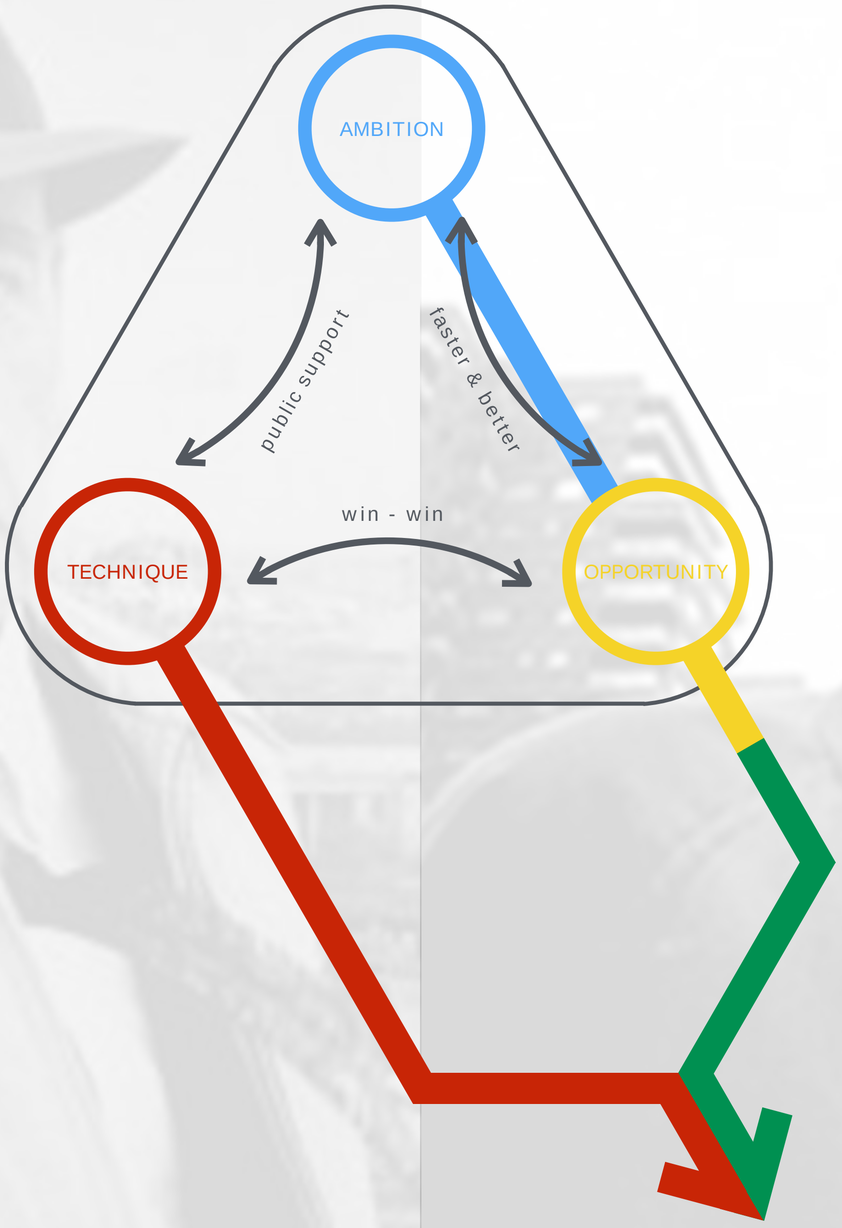
A SYSTEMS APPROACH

BLUE MARBLE Dec 7 1972, Apollo 17


long term &
comprehensive
ppp funding &
accountability
programmatic approach
&
institutional capacity
inclusive
collaboration
short term &
innovative


research & planning & design
long term &
comprehensive
ppp funding &
accountability
programmatic approach
&
institutional capacity
inclusive
collaboration
short term &
innovative
understand & value & manage

DESIGN, PLANNING AND INNOVATION



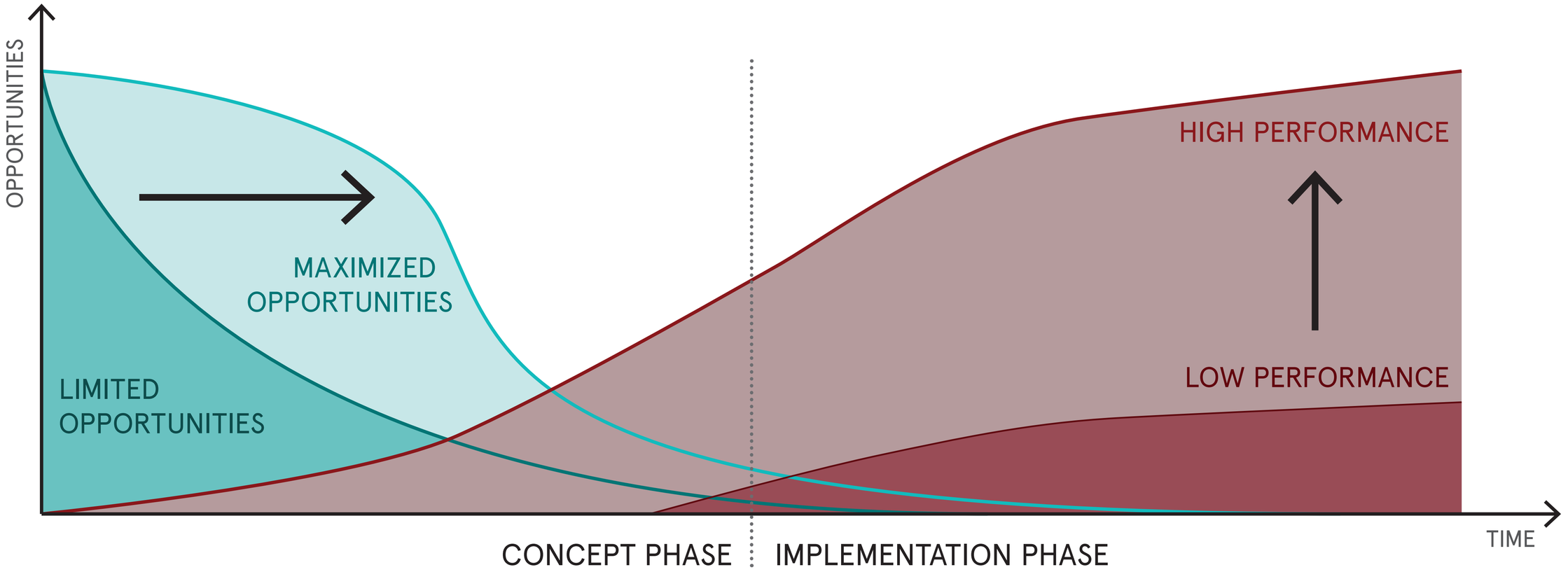
enabling *environment*


PROJECTS
implementation
enabling
environment
/ capacity
> Collaboration
> Consistency
> Capacity building
> Commitment
> Cross-cutting
PEOPLE

the coalition *of the willing*


A Safe Place
Collaborate (not negotiate)
Talent Meets Talent
Inclusive Leadership

We need millions to spend billions (right)...



Opportunity-Performance Curve. The economic production possibility curve (PPC) shows possible combinations of two goods that can be produced with constant resources & technology, resulting in less production of it.

Similar dynamics take place in development: it is important to keep opportunities open as long as possible.

Delaying decisions too long can have a negative impact on the project if not managed right and recent studies show that the proper management of these options & opportunities has a clear positive impact on the value of the project's performance.

Investing more intensively in the concept phase and using that knowledge to actively engage in decision-making, guarantees a more extensive performance rate during implementation.

The Netherlands - culture of living with water

Trade, negotiations and crafts, stubbornness, luck and faith.

Managing risks and uncertainties.

The Netherlands is made out of water

County of Holland, 16th Century Woodcut by Sebastian Münster

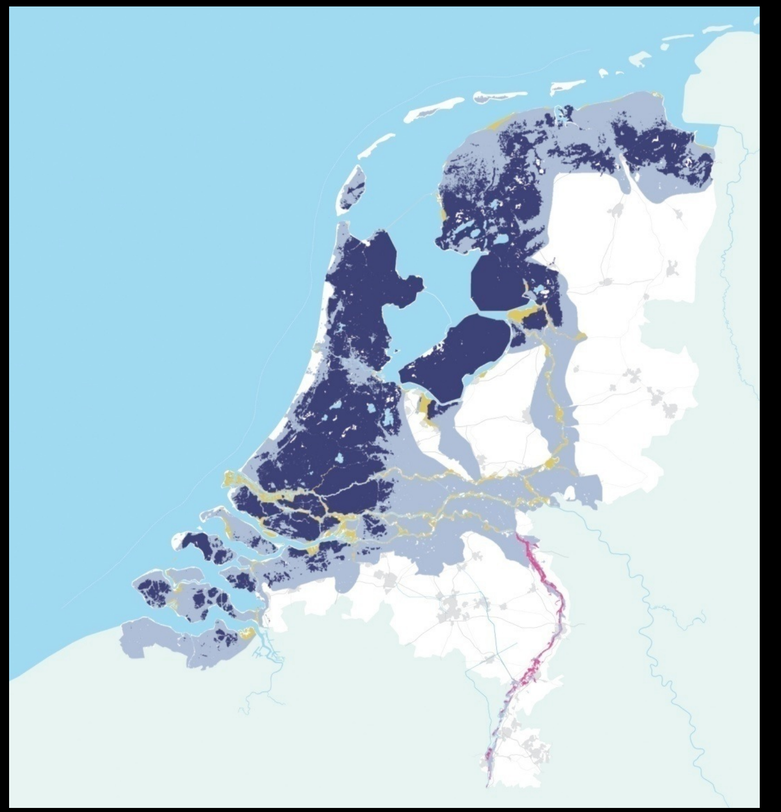
Below sea level: 26%

Above sea level: 29%

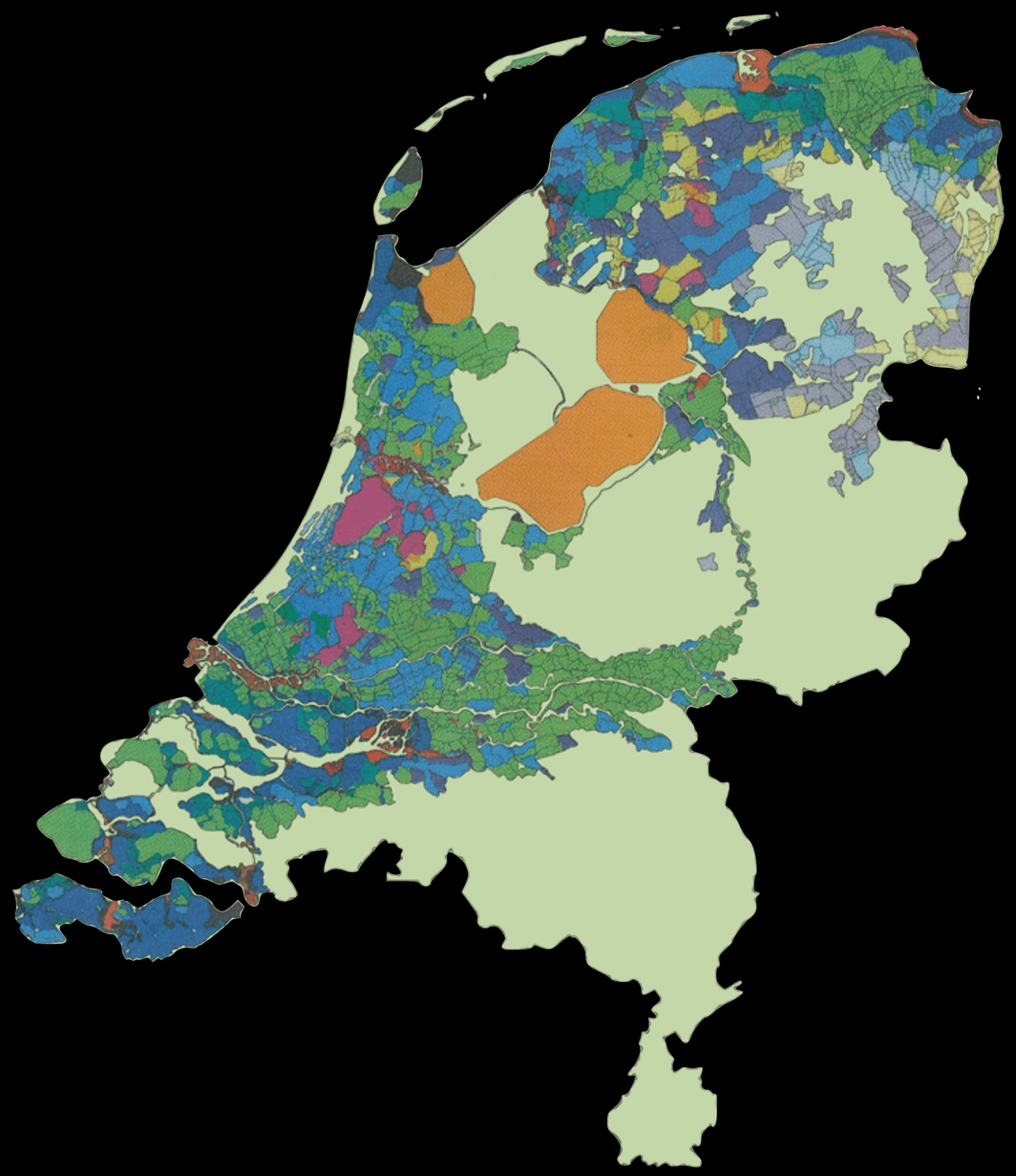
Outside the dykes: 3%

Meuse outside the dykes: 1%

Liable to flooding: 59%



MAN MAKING LAND: 3500+ DUTCH POLDERS



MAN MAKING LAND: 3500+ DUTCH POLDERS

1122 - the first collaboration started in the Utrecht area, where 20 communities worked together on the local embankment

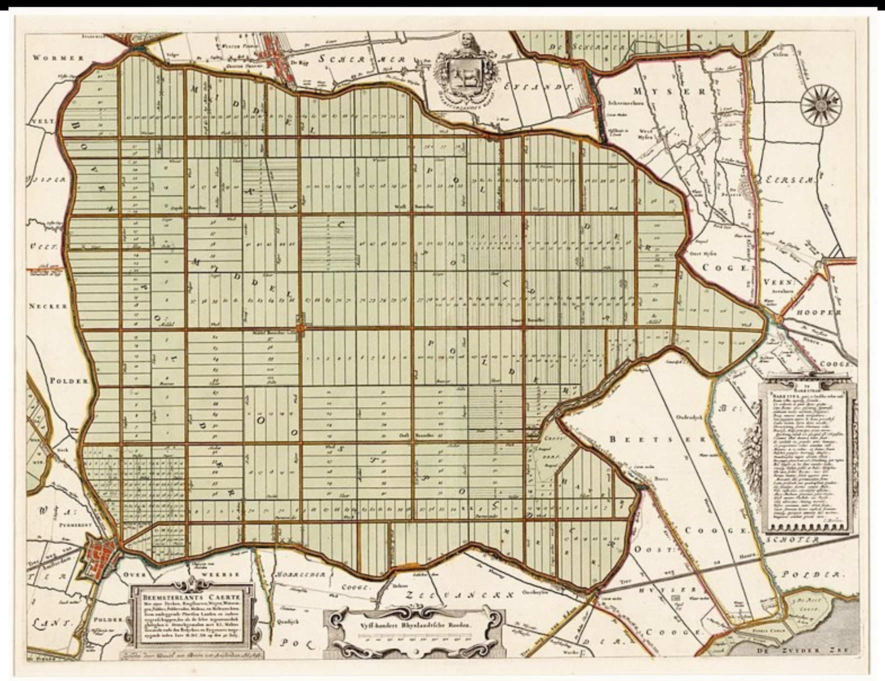
two principles :

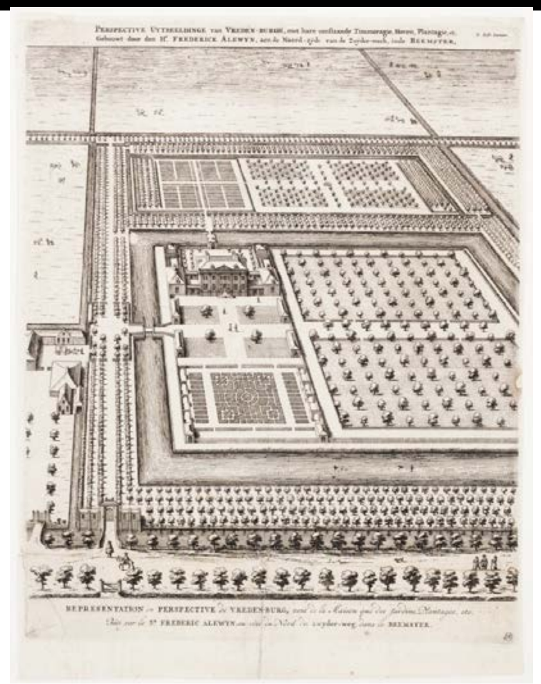
SAFETY

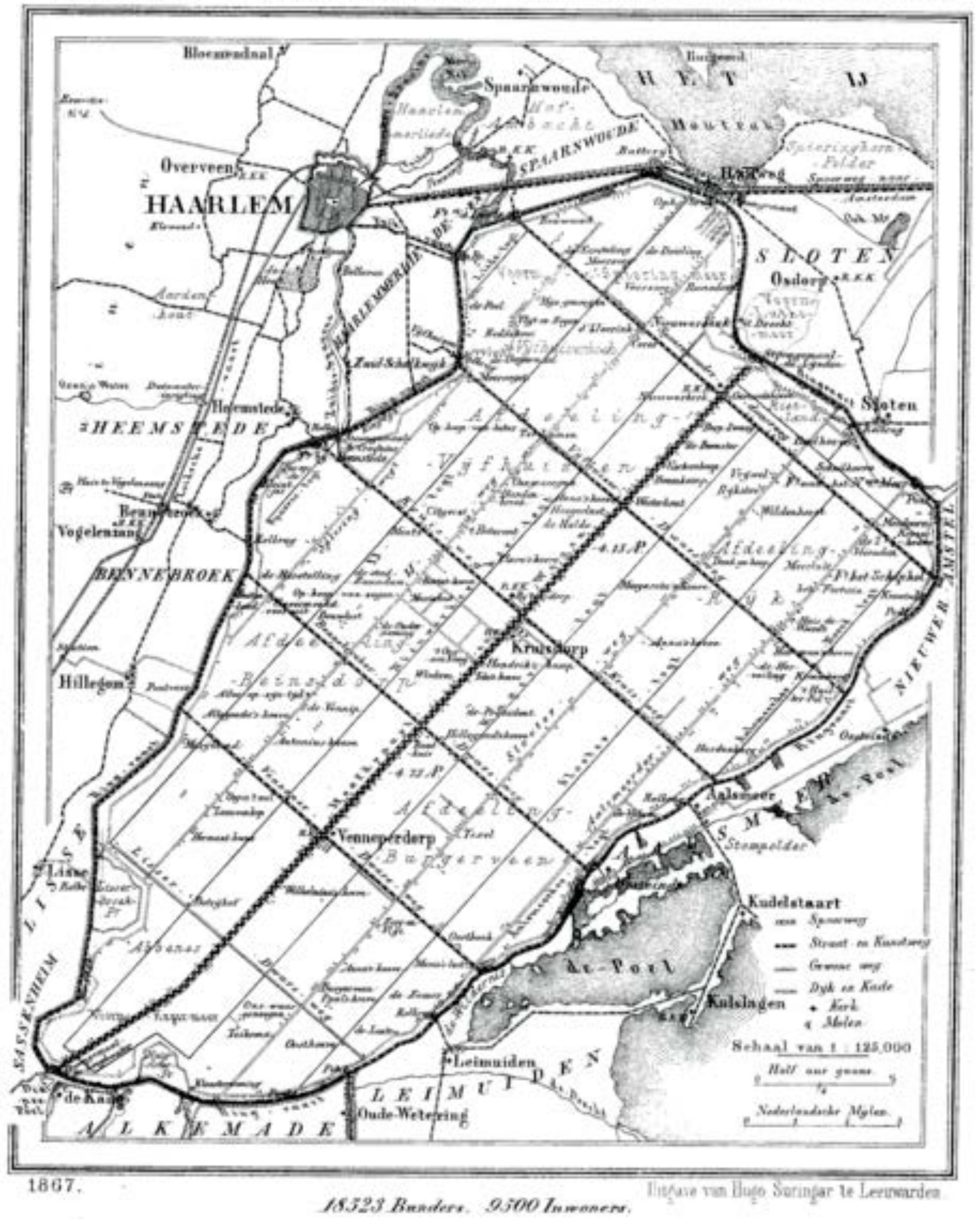
and

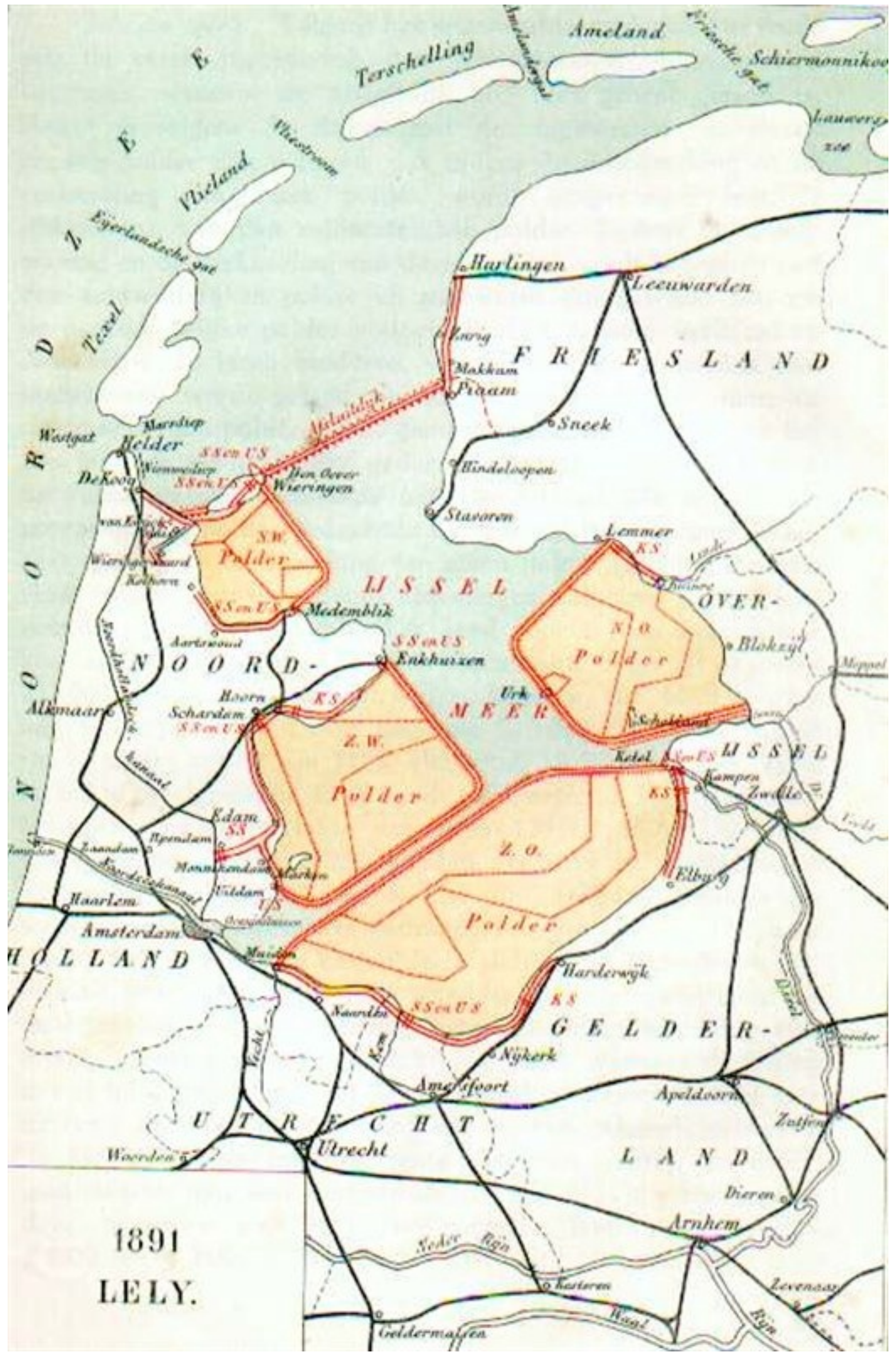
QUALITY

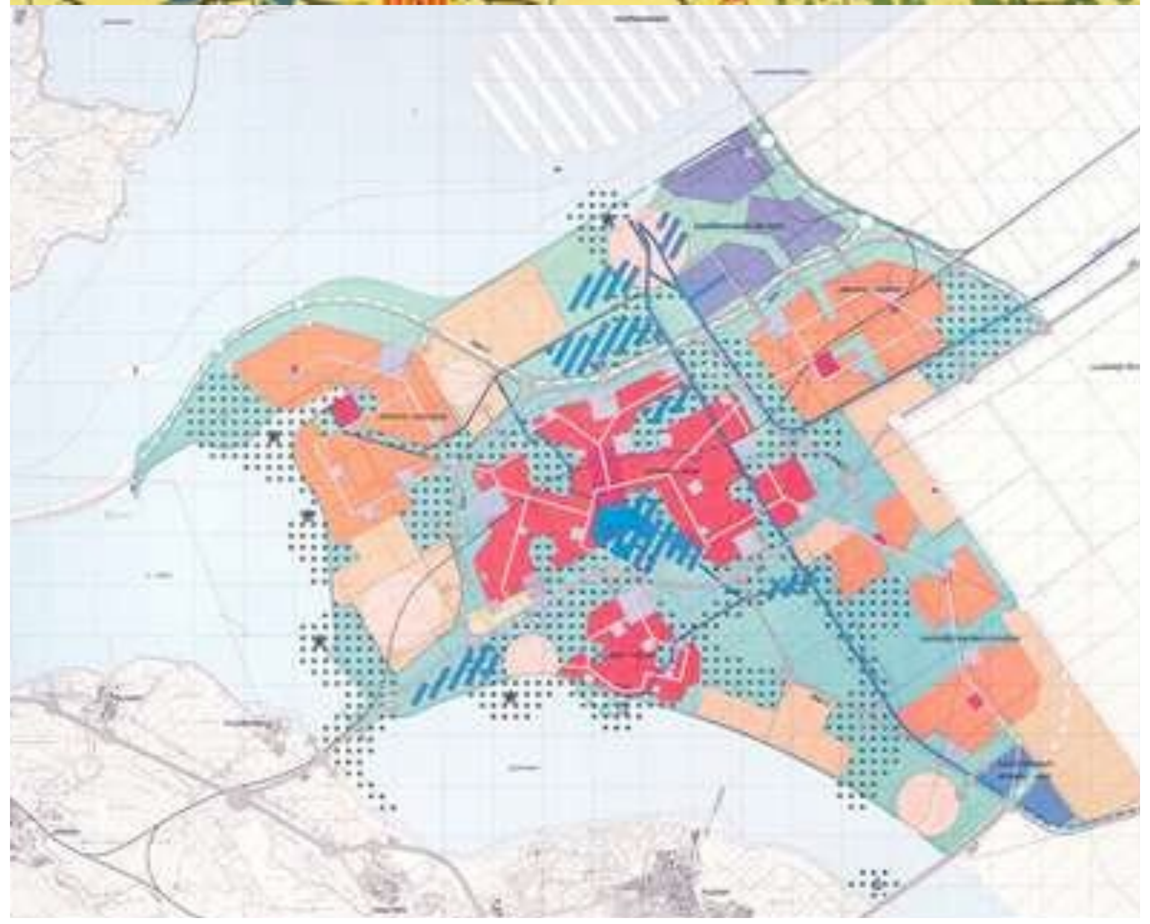
MAKING LAND: 3500+ DUTCH POLDERS







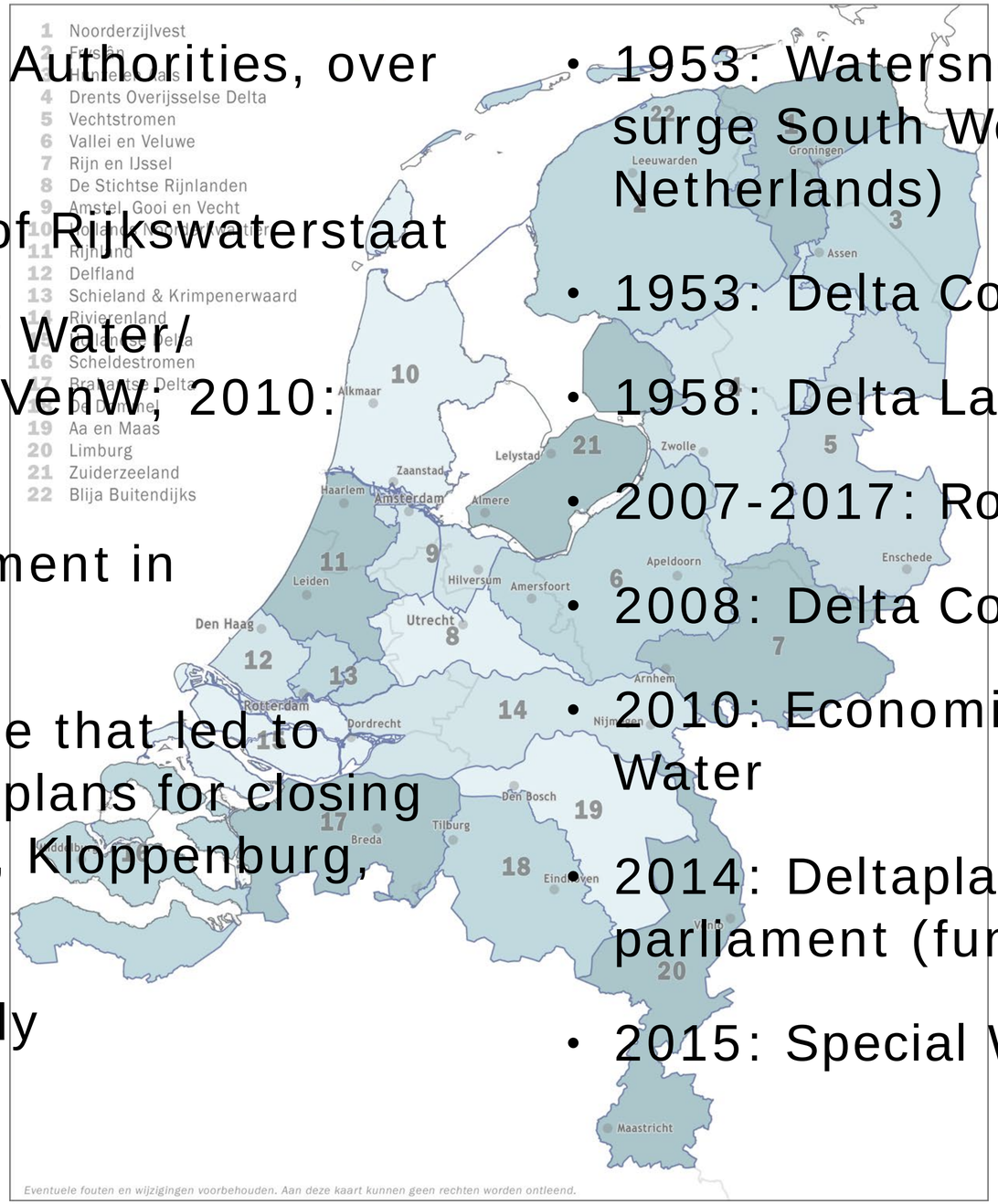




WATERLAND, WATERCITIES

Transforming the institutional

- 1122: Regional Water Authorities, over 3000, now 21
- 1798: Establishment of Rijkswaterstaat
- 1809-now: Ministry of Water / Infrastructure (1947: VenW; 2010: IenM; 2017: IenW)
- 1814: Water management in Constitution
- 1916: Disastrous surge that led to decisions on previous plans for closing the Zuiderzee (Stevin, Kloppenburg, Faddegon)
- 1916: Deltaplan dr Lely
- 1918: Zuiderzee Law



- 1953: Watersnoodramp (disastrous surge South Western part of the Netherlands)
- 1953: Delta Committee
- 1958: Delta Law
- 2007-2017: Room for the River
- 2008: Delta Committee
- 2010: Economic approach: Topsector Water
- 2014: Deltaplan accepted by parliament (funding until 2050)
- 2015: Special Water Envoy…

Water quality - from response to preparedness

CHOLERA-COMMISSIE.

De *Cholera-Commissie* waarschuwt nogmaals met nadruk tegen het gebruik van

ONRIJPE VRUCHTEN,
PRUIMEN,
KOMKOMMERS,
MELOENEN,
GARNALEN.

OUDERS behooren zorg te dragen dat hunne *kinderen* zich niet in 't geheim *vruchten* verschaffen.

Voor *goed Drinkwater* behoort steeds gezorgd te worden, als zoodanig wordt

DUINWATER

aanbevolen.

AMSTERDAM, 24 *Julij* 1866.

Namens de CHOLERA-COMMISSIE.

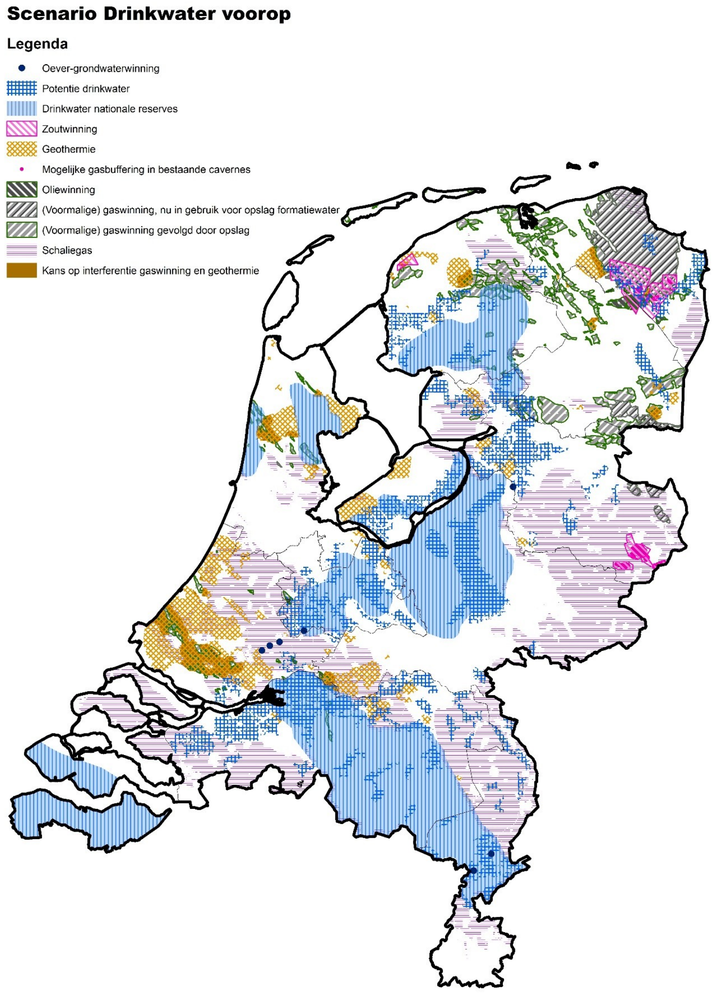
G. A. N. ALLEBÉ, *Voorzitter.*

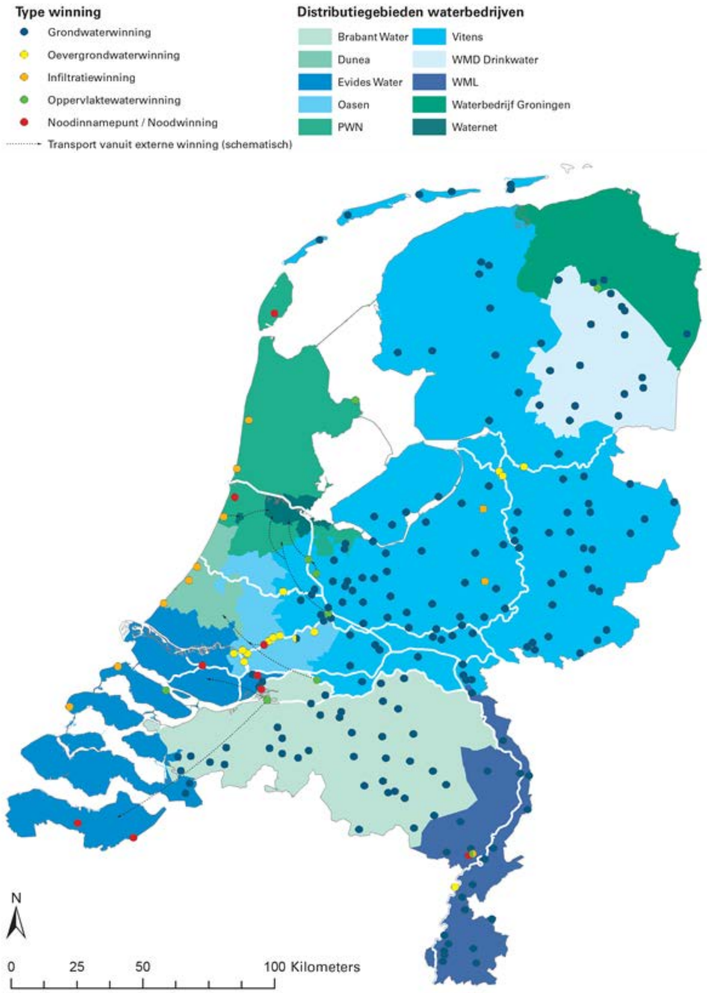
A. ROLAND HOLST, 2de *Secretaris.*

Te Amsterdam, ter STADS-DRUKKERIJ, in de Nes.

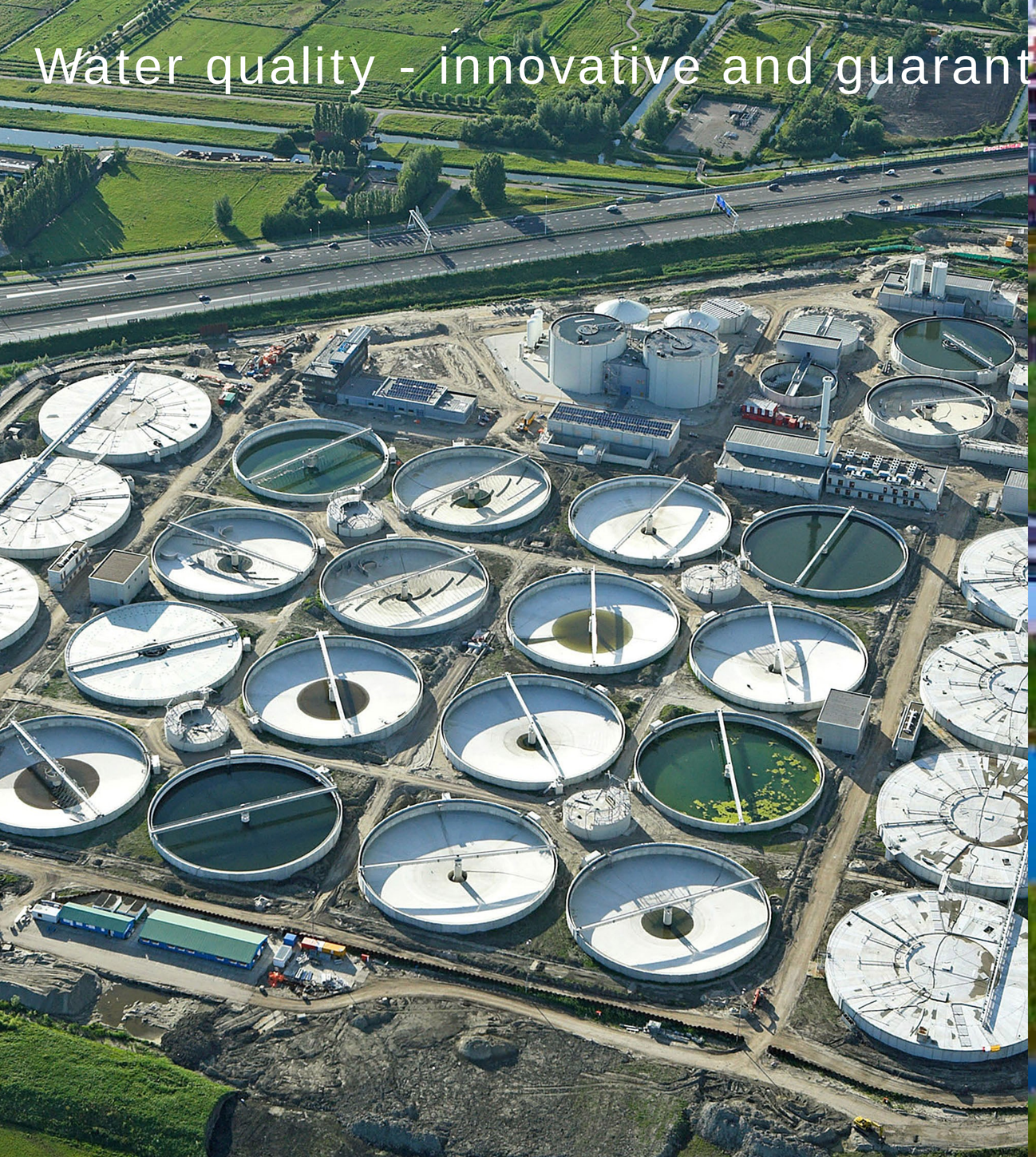
Water quality - from response to preparedness - Woningwet

Water quality - system and governance > Deltaprogram Fresh Water Supply





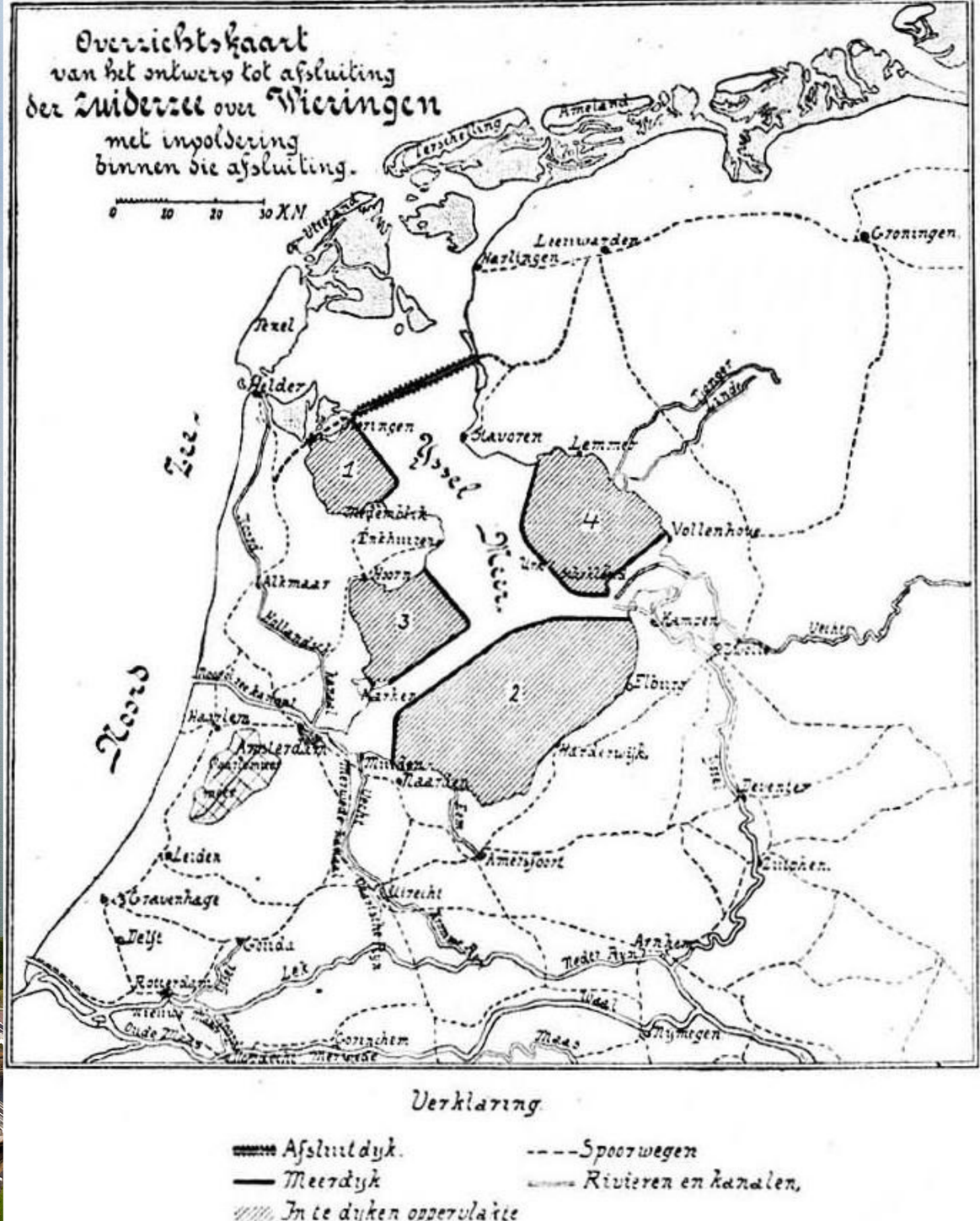
Water quality - innovative and guaranteed



Zuiderzee works

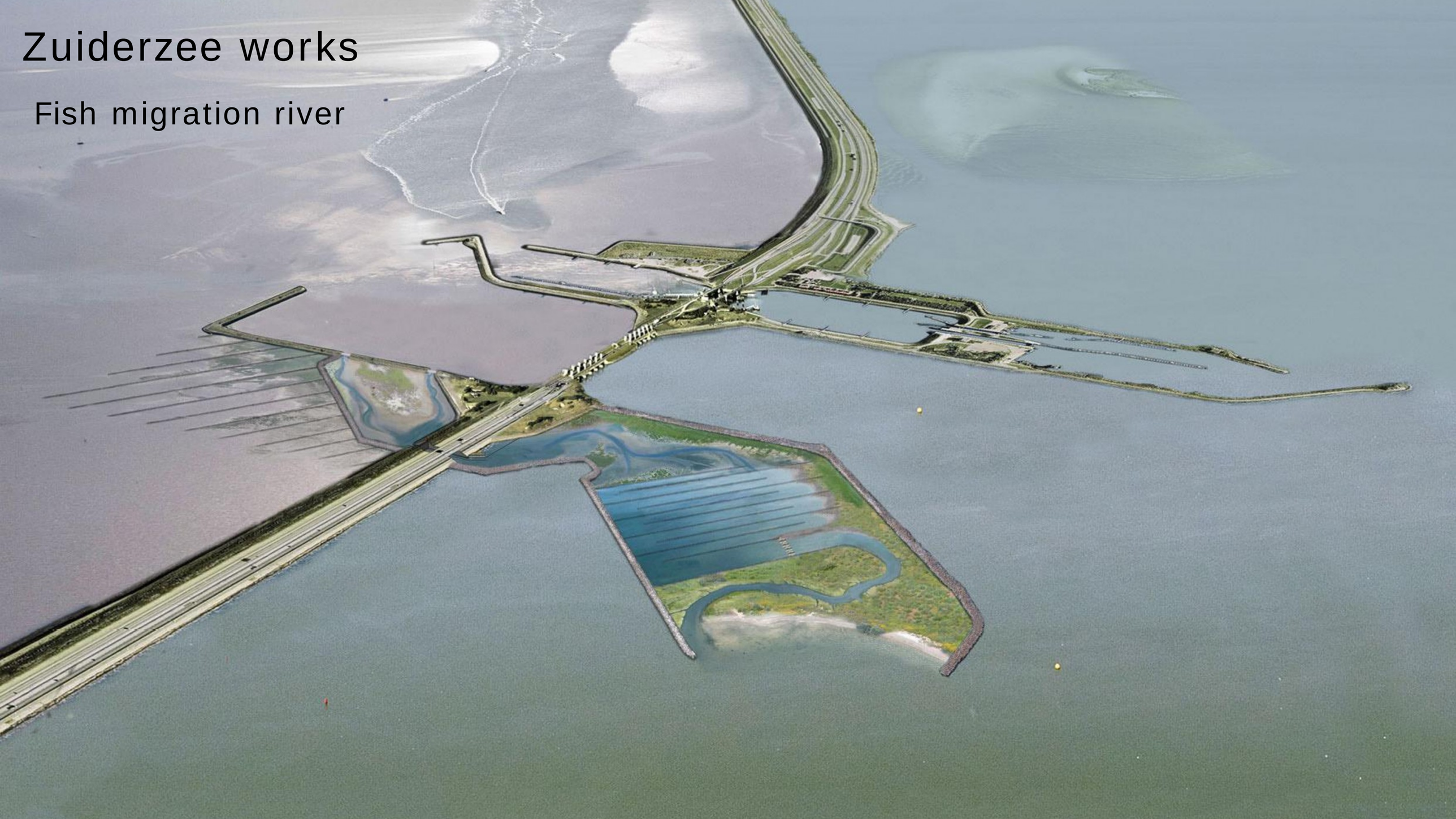
1916 flood

- Response: Zuiderzee works
- Enclosure dam of Zuiderzee and 5 polders



Zuiderzee works

Fish migration river

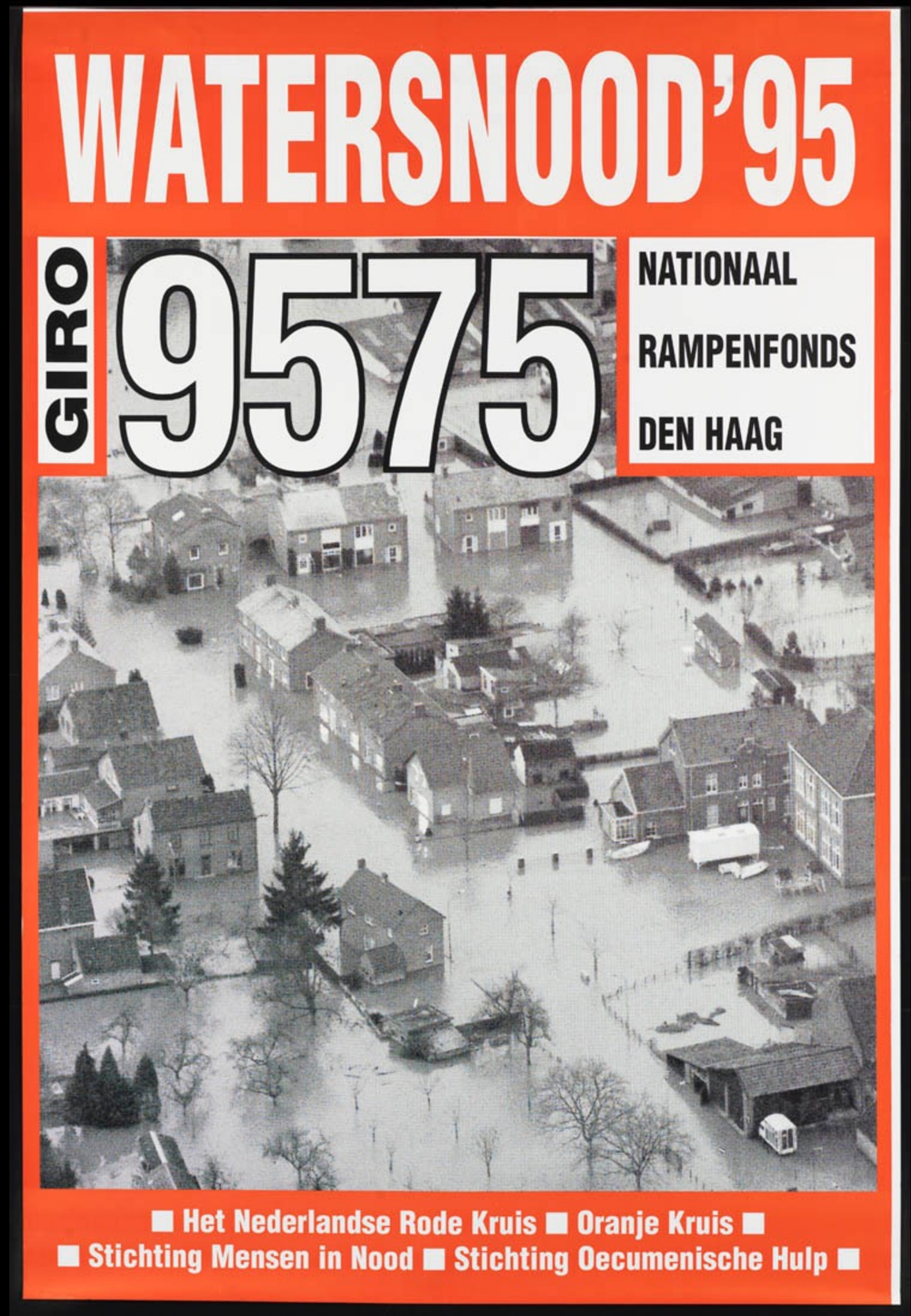


1953

Post 1953: Delta works + new safety strategy

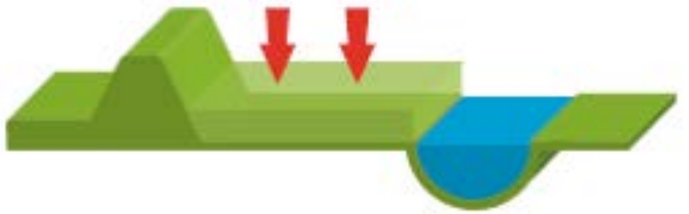
- Delta commission
- Delta works scheme
- Closing off estuaries
- Compartimention works
- Shorter coast line and fresh water reservoirs
- New closure techniques,
- New safety strategy
- National dike designs based on frequency of water levels

1995
250.000 people
evacuated



Room for the River: 39 projects – € 2.3 bln

Lowering of floodplains



Dike relocation

High-water channel

Strengthening dikes

RIVERINE - Room for the River: Waalsprong Nijmegen

Algemene Rekenkamer

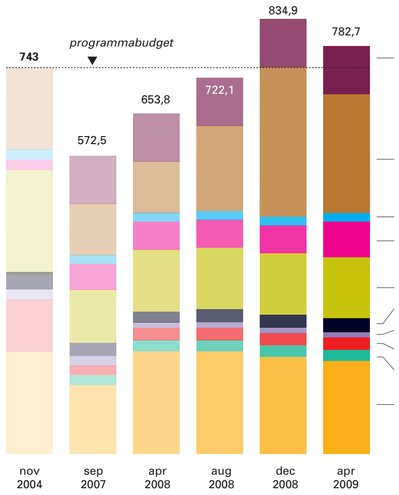
Deze informatie is gebaseerd op een onderzoek van de Algemene Rekenkamer. Over de uitkomsten is de Tweede Kamer in het najaar van 2009 per brief geïnformeerd. Deze poster is een bijlage bij de betreffende brief.

Kosten van het programma *Zwakke Schakels Kust*

De Nederlandse kust telt enkele 'zwakke schakels'. De zeewering voldoet hier niet meer aan de veiligheidsnorm. Dit is gebleken uit een toets die in 2003 is uitgevoerd. Op tien plaatsen laat het Ministerie van Verkeer en Waterstaat de zeeweringen versterken. Hiervoor is het programma 'Zwakke Schakels Kust' opgezet. De tien locaties moeten vóór 2015 zijn aangepakt. Het ministerie heeft hiervoor een programmabudget gereserveerd van € 743 miljoen.

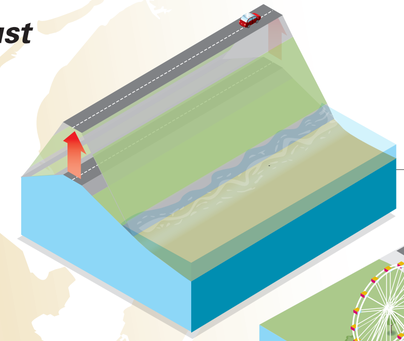
Ontwikkeling totale geraamde kosten programma *Zwakke Schakels Kust*

Onderverdeeld naar project, op zes momenten in de tijd
(in miljoenen euro's)



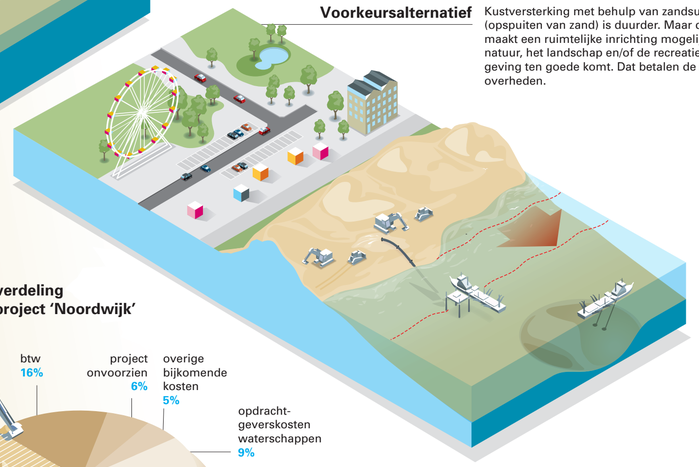
Doel: veiligheid én ruimtelijke kwaliteit

Het programma Zwakke Schakels Kust richt zich op gelijktijdige verbetering van de veiligheid en de ruimtelijke kwaliteit. Deze dubbeldoelstelling leidt tot hogere kosten voor het Ministerie van Verkeer en Waterstaat. Dat zit hem niet in de benodigde investeringen in de ruimtelijke inrichting; de decentrale overheden ter plaatse dragen deze kosten. Maar het bijbehorende veiligheidsalternatief (bijvoorbeeld: zandsuppletie) is in veel gevallen duurder dan een eenvoudige oplossing als dijkverhoging, die ook voldoet aan de veiligheidsnorm. De meerkosten bedragen voor het gehele programma tot nu toe rond de € 107 miljoen (14%).

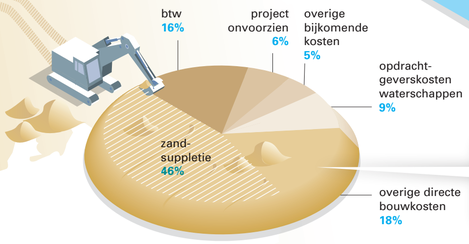


Sober alternatief De soberste oplossing zou zijn het simpelweg verhogen van de dijken langs de kust. Veiligheid (voorkomen van overstromingen) is dan het enige doel.

Voorkeursalternatief Kustversterking met behulp van zandsuppleties (opspuiten van zand) is duurder. Maar deze oplossing maakt een ruimtelijke inrichting mogelijk die de natuur, het landschap en/of de recreatie in de omgeving ten goede komt. Dat betalen de regionale overheden.



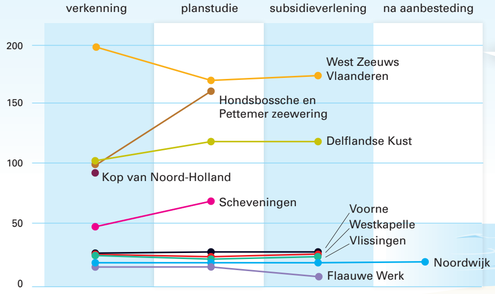
Kostenverdeling bij het project 'Noordwijk'



In Noordwijk is de aanpak van de kustversteviging het verst gevorderd. De verdeling van de uitgaven over de diverse kostenposten ziet er hier als volgt uit. We zien dat bijna de helft van de uitgaven betrekking heeft op kosten voor zandsuppletie.

Hoe worden de kosten in opeenvolgende projectfasen beheerst?

Per fase, per project (in miljoenen euro's)

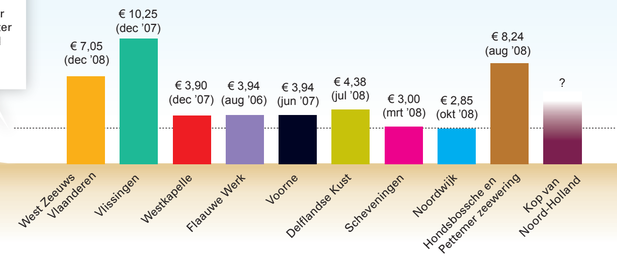


Bij de meeste kustprojecten blijven de geraamde kosten in de opeenvolgende projectfasen vooralsnog min of meer stabiel.

Belangrijke kostenfactor: de prijs van zandsuppletie

De prijs die betaald moet worden voor het winnen van zand uit de zeebodem en het opspuiten daarvan op het land, heeft grote invloed op de kosten van het programma. Voor strand- of duinopspuiting zijn namelijk tientallen miljoenen kubieke meters zand nodig.

Geraamde zandprijs per project, per m³



Bij de start van het programma werd uitgegaan van een zandsuppletieprijs van € 3 per kubieke meter. Dat bleek echter een historisch lage prijs; eind 2008 lag de prijs rond de € 7 per kubieke meter.

Dike in Dune - parking garage Katwijk

Tweede Maasvlakte

COASTAL - Zandmotor “sandmotor”

URBAN - Watersquares Rotterdam

Amsterdam Rainproof

A network platform for dry feet and an attractive city

Kristalbad

A combination of water storage, natural water purification and recreation

Eendragtspolder

Combines on 300 hectares international sports facilities and 4 million m3 waterstorage

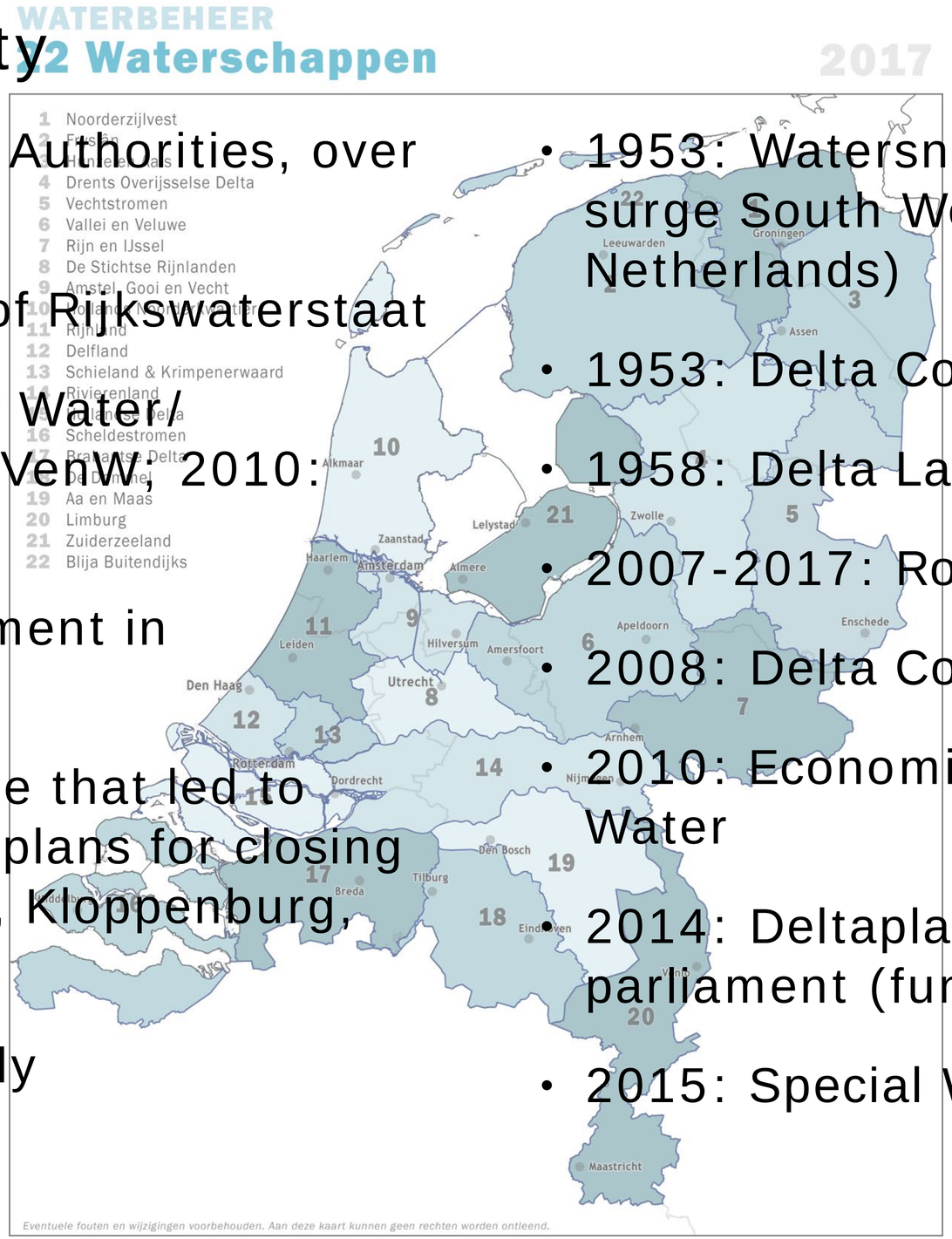
enabling *environment*

&

institutional capacity

Institutional capacity

- 1122: Regional Water Authorities, over 3000, now 21
- 1798: Establishment of Rijkswaterstaat
- 1809-now: Ministry of Water / Infrastructure (1947: VenW; 2010: IenM; 2017: IenW)
- 1814: Water management in Constitution
- 1916: Disastrous surge that led to decisions on previous plans for closing the Zuiderzee (Stevin, Kloppenburg, Faddegon)
- 1916: Deltaplan dr Lely
- 1918: Zuiderzee Law



- 1953: Watersnoodramp (disastrous surge South Western part of the Netherlands)
- 1953: Delta Committee
- 1958: Delta Law
- 2007-2017: Room for the River
- 2008: Delta Committee
- 2010: Economic approach: Topsector Water
- 2014: Deltaplan accepted by parliament (funding until 2050)
- 2015: Special Water Envoy…

Institutional layers of water management in the Netherlands

European level

European Union

Legislation and regulation for water, floods and the environment

International River Basin Commissions (Rhine, Scheldt, Meuse, Ems)

Cross-border water management

National level

Ministry of Infrastructure and Watermanagement

Water, spatial planning and flood protection at national level

Planning of the national water policy

Co-ordination with other policy areas (spatial planning, environment, economic development, agriculture, etc.)

National Water Authority

Operation and maintenance of main water system

Provincial level

Provinces (12)

Integrated spatial and environmental planning

Supervision of regional water authorities (RWAs)

Groundwater regulation

Co-ordination with other regional policy areas

Watershed level

Regional water authorities (24)

Operation and management of regional water systems

Flood defence

Water quality & water quantity

Wastewater transport & treatment

Municipal level

Municipalities (408)

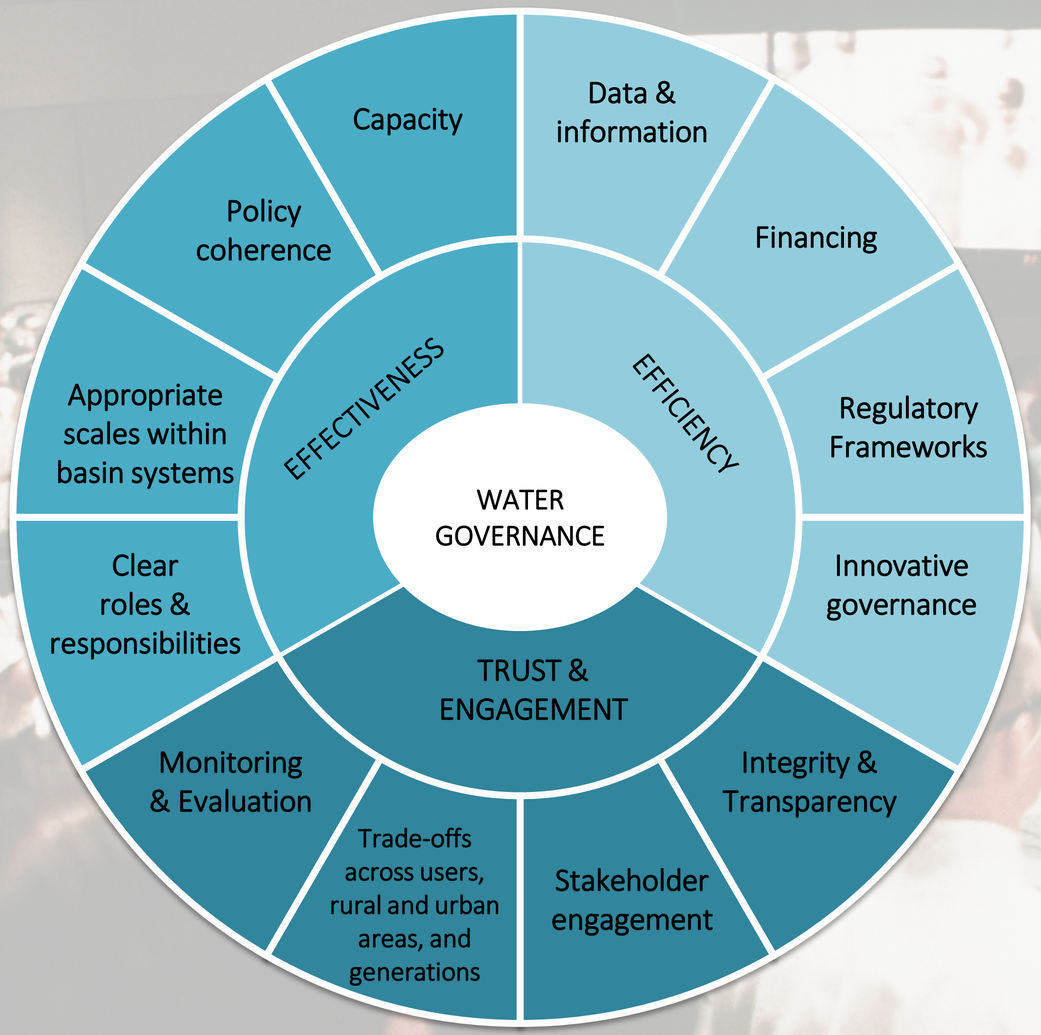
Local spatial planning

Sewerage collection & wastewater transport

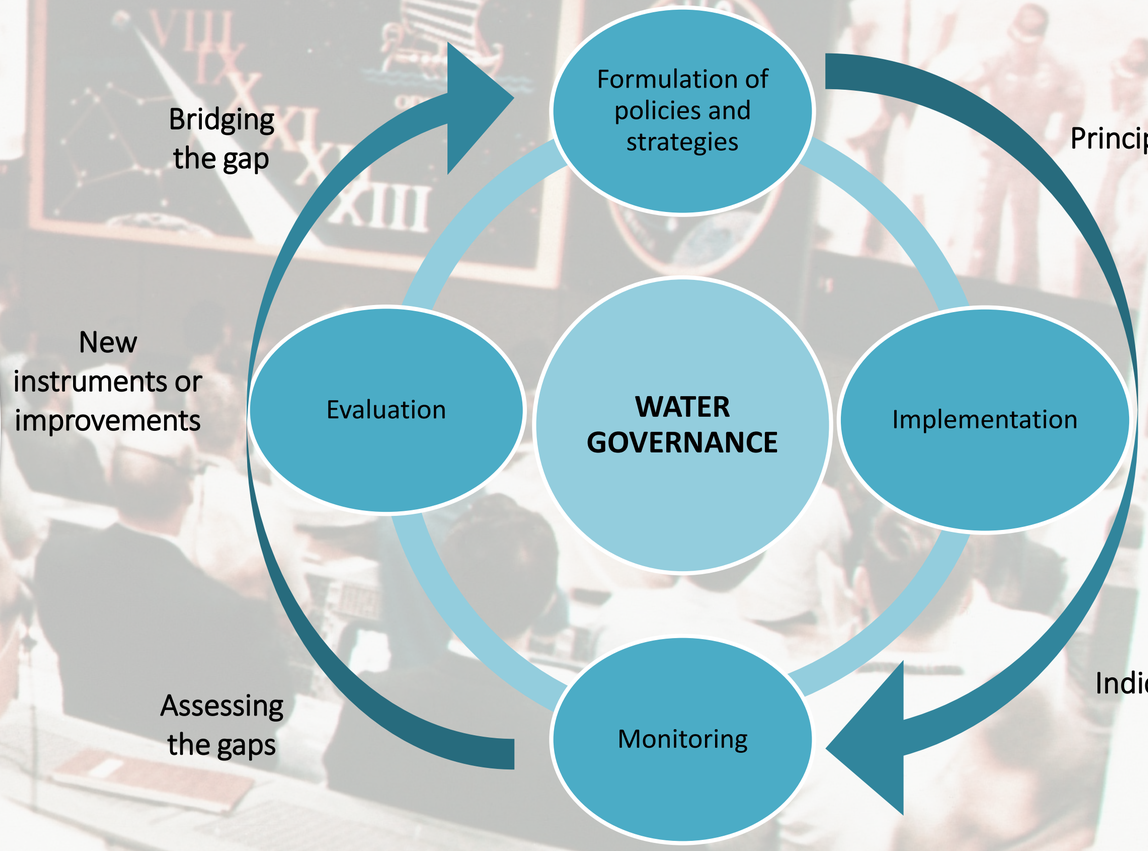
Urban drainage

Stormwater collection

Overview of OECD Principles on Water Governance



The Water Governance Cycle



Source: Forthcoming, OECD Working Paper, 2015, Water Governance Indicators

The OECD Principles on Water Governance are expected to contribute to improving the "Water Governance Cycle" from policy design to implementation.

DUTCH DELTA APPROACH

Multi-layered approach:

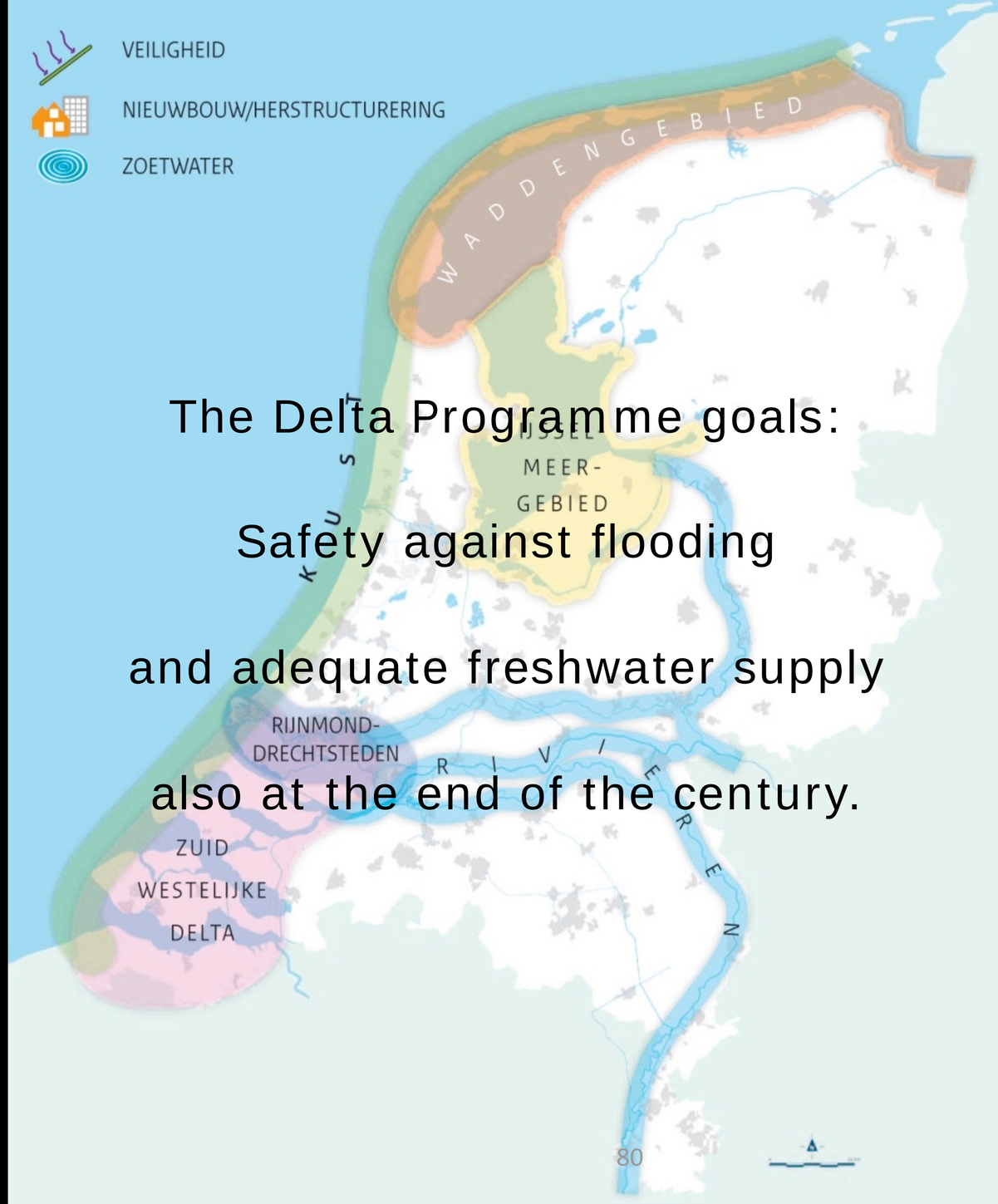
3. RESPONSE:
Disaster management

2. PLAN
Land use planning
(new developments,
vital infrastructure)

1. PROTECT
Dam's, dikes, levees,
dunes,....

Proper organization: prerequisites for future-proof implementation

- Delta Act, legal base for Delta program, fund and commissioner
- Delta Program (*providing continuous implementation*),
- Delta Fund, 1.0 bln € / yr (*providing financial stability*),
- Delta Commissioner (*providing leadership*),
- Delta decisions (*providing strategic direction for the long term*).



The Delta Programme goals:

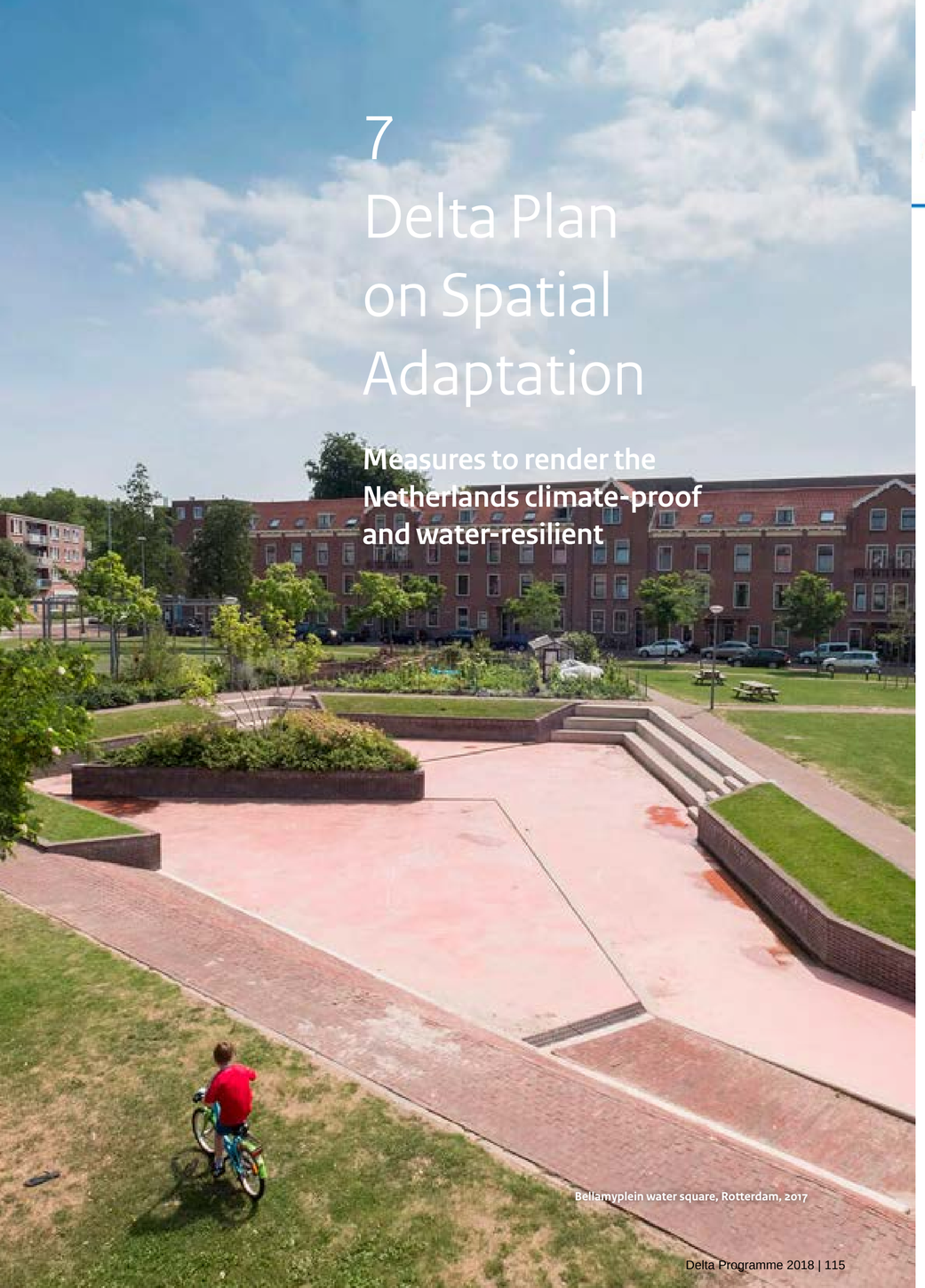
Safety against flooding

and adequate freshwater supply

also at the end of the century.

7 Delta Plan on Spatial Adaptation

Measures to render the Netherlands climate-proof and water-resilient



Bellamyplein water square, Rotterdam, 2017

7 ambitions

Water-resilient and climate-proof spatial planning in the Netherlands

Hurricane Irma – Sint Maarten

PPP HACK-A-THON SINT MAARTEN

ARUBA CENTRE OF EXCELLENCE FOR SUSTAINABLE DEVELOPMENT OF SIDS

GOBIERNO DI ARUBA

Kingdom of the Netherlands
Your Partner for Peace, Justice and Development

UNDP
Empowered lives.
Resilient nations.

3 DAYS
166 PARTICIPANTS
21 DO-TANK TEAMS
45 INTERNATIONAL COMPANIES
8 EXPERT SESSIONS
1 NEXTGEN MOBILE SOCOCO WALL
100 KG. TRASH COLLECTED
1 MOU

21 IDEAS!

Sustainable Tourism
Bini Travel all-inclusive app (1)
Flamboyant beach resort (7)
Ecotech for Ecotourism (13)
ShowMe Caribbean on-location videos (18)

Renewable Energy
Slow mill wave energy (8)
Collective Impact Initiative (21)

Environment
Algae – salt pond green again (6)

Construction
Hive five sustainable housing (3)
Super House emergency shelters (5)
E-hub self-sustaining housing box (11)
C-D'Home resilient homes (14)
DAM better window frames (20)

Social
PCCC Cultural Center (2)
The Force social innovation network (4)
CITS community innovative technological solutions (9)
Maatin - Siri-like info platform (19)

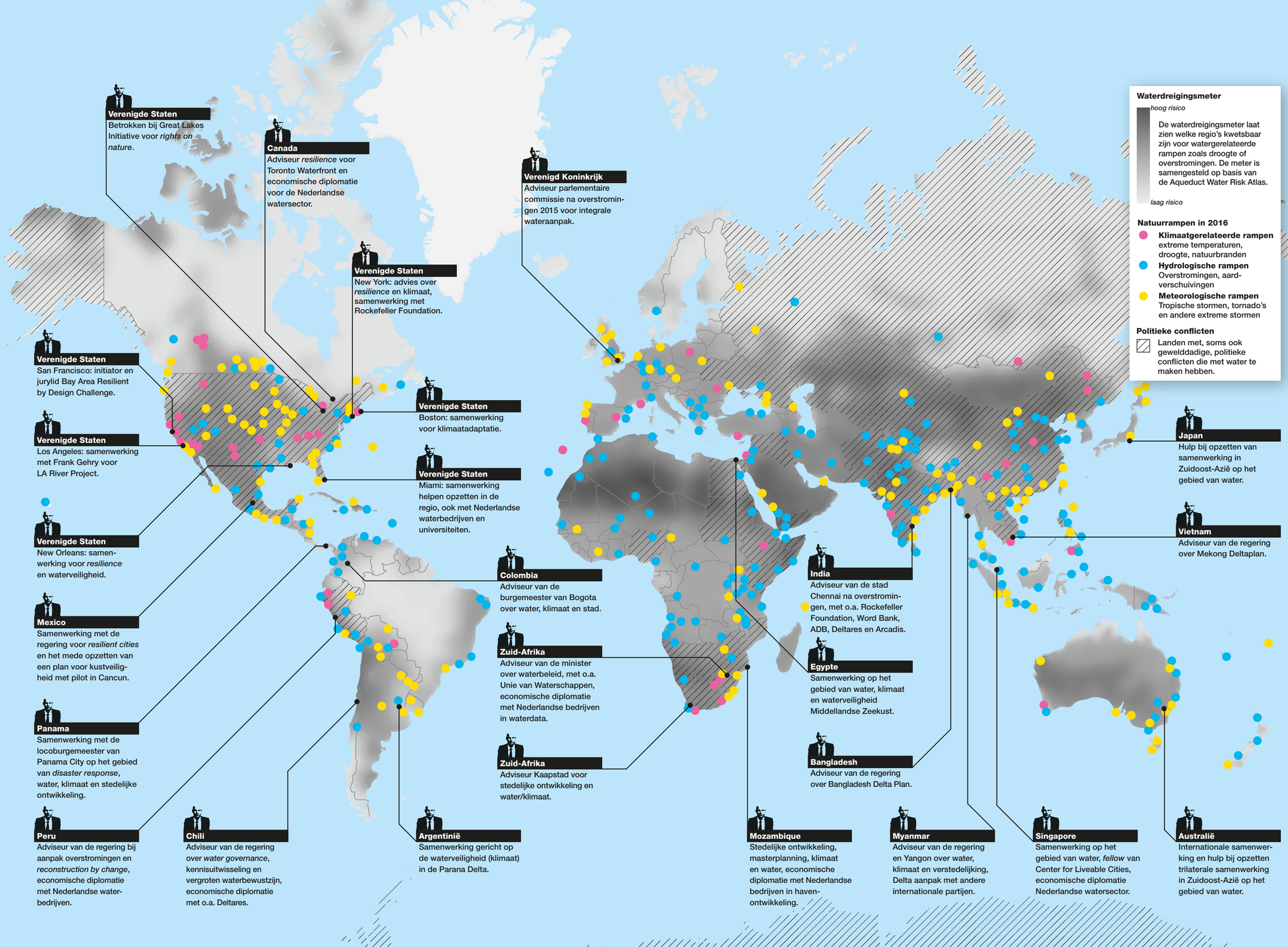
Entrepreneurship
Discovery platform for sustainable solutions (10)

Waste management
Green Box recycling rewards program (12)
Solar Flamboyant park (16)

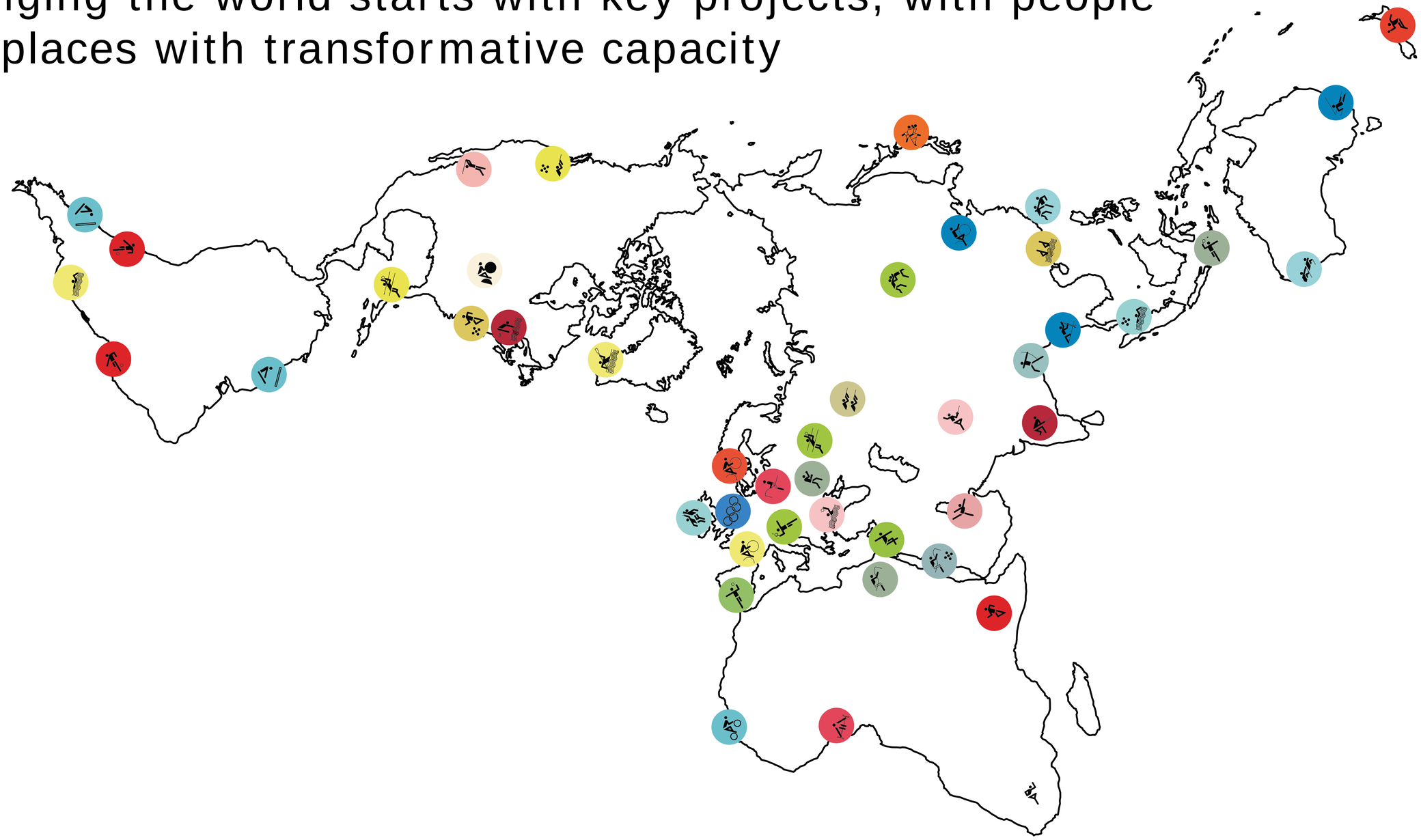
Disaster management
SXM AX disaster response app (17)
Better bunker box for critical communication (15)

global *coalition*

let's work TOGETHER


Verenigde Staten
Betrokken bij Great Lakes Initiative voor *rights on nature*.
Canada
Adviseur *resilience* voor Toronto Waterfront en economische diplomatie voor de Nederlandse watersector.
Verenigd Koninkrijk
Adviseur parlementaire commissie na overstromingen 2015 voor integrale wateraanpak.
Verenigde Staten
New York: advies over *resilience* en klimaat, samenwerking met Rockefeller Foundation.
Verenigde Staten
San Francisco: initiator en jurylid Bay Area Resilient by Design Challenge.
Verenigde Staten
Boston: samenwerking voor klimaatadaptatie.
Verenigde Staten
Los Angeles: samenwerking met Frank Gehry voor LA River Project.
Verenigde Staten
Miami: samenwerking helpen opzetten in de regio, ook met Nederlandse waterbedrijven en universiteiten.
Verenigde Staten
New Orleans: samenwerking voor *resilience* en waterveiligheid.
Colombia
Adviseur van de burgemeester van Bogota over water, klimaat en stad.
Mexico
Samenwerking met de regering voor *resilient cities* en het mede opzetten van een plan voor kustveiligheid met pilot in Cancun.
Zuid-Afrika
Adviseur van de minister over waterbeleid, met o.a. Unie van Waterschappen, economische diplomatie met Nederlandse bedrijven in waterdata.
Panama
Samenwerking met de locoburgemeester van Panama City op het gebied van *disaster response*, water, klimaat en stedelijke ontwikkeling.
Zuid-Afrika
Adviseur Kaapstad voor stedelijke ontwikkeling en water/klimaat.
Peru
Adviseur van de regering bij aanpak overstromingen en *reconstruction by change*, economische diplomatie met Nederlandse waterbedrijven.
Chili
Adviseur van de regering over *water governance*, kennisuitwisseling en vergroten waterbewustzijn, economische diplomatie met o.a. Deltares.
Argentinië
Samenwerking gericht op de waterveiligheid (klimaat) in de Parana Delta.
India
Adviseur van de stad Chennai na overstromingen, met o.a. Rockefeller Foundation, Word Bank, ADB, Deltares en Arcadis.
Egypte
Samenwerking op het gebied van water, klimaat en waterveiligheid Middellandse Zeekust.
Bangladesh
Adviseur van de regering over Bangladesh Delta Plan.
Mozambique
Stedelijke ontwikkeling, masterplanning, klimaat en water, economische diplomatie met Nederlandse bedrijven in haven-ontwikkeling.
Myanmar
Adviseur van de regering en Yangon over water, klimaat en verstedelijking, Delta aanpak met andere internationale partijen.
Singapore
Samenwerking op het gebied van water, *fellow* van Center for Liveable Cities, economische diplomatie Nederlandse watersector.
Australië
Internationale samenwerking en hulp bij opzetten trilaterale samenwerking in Zuidoost-Azië op het gebied van water.
Japan
Hulp bij opzetten van samenwerking in Zuidoost-Azië op het gebied van water.
Vietnam
Adviseur van de regering over Mekong Deltaplan.
Waterdreigingsmeter
hoog risico
De waterdreigingsmeter laat zien welke regio's kwetsbaar zijn voor watergerelateerde rampen zoals droogte of overstromingen. De meter is samengesteld op basis van de Aqueduct Water Risk Atlas.
laag risico
Natuurrampen in 2016
Klimaatgerelateerde rampen
extreme temperaturen, droogte, natuurbranden
Hydrologische rampen
Overstromingen, aardverschuivingen
Meteorologische rampen
Tropische stormen, tornado's en andere extreme stormen
Politieke conflicten
Landen met, soms ook gewelddadige, politieke conflicten die met water te maken hebben.

Changing the world starts with key projects, with people and places with transformative capacity



THE NETHERLANDS
ROOM FOR THE RIVER

Name: **Dutch River Region**
Population: **4 million**
Urban or rural: **Rural**
Above or below sealevel: **Just above**
Total investment: **EUR 2.3 billion**

Extremely high water levels. That is the greatest challenge the river region in the Netherlands faces today. In 1993 and 1995, water levels in the Netherlands reached a critical level, weakening the dikes to the point of collapse. A quarter of a million inhabitants had to be evacuated, along with one million cattle. As heavy rainfall is becoming more common – and will become even more so in the future – the Dutch government is continually working on ensuring the safety of the river regions through programmes such as Room for the River.

Reinforcing dikes is not an adequate solution. In order to drain excess water into the sea, measures must also include widening and deepening rivers. At more than 30 locations, the Room for the River Programme allows rivers more space, for example by moving dikes, digging secondary channels and deepening flood plains.

The Room for the River Programme uses a globally innovative approach to protect areas against river flooding. Giving the river more room not only protects the river regions from floods but also improves the overall quality of the area, with new nature and recreational areas as an added bonus. In short, an integrated approach improves both safety and spatial quality. Multiple Dutch partners including central government, and local provinces, municipalities and water boards, companies and NGOs are implementing the Room for the River Programme. This close cooperation between national and regional governments ensures support and reduces the risk of delays.

Room for the River is a pilot programme for the Dutch Delta Programme, which is designed to prepare the Netherlands for extreme natural events. The main objective of this programme is to make water safety and freshwater supplies sustainable and predictable by 2050. The Dutch Delta approach is based on five Ds: Delta Act, Delta Fund, Delta Commissioner, Delta Decisions and Delta Programme. The so-called Delta Decisions, for example guide the concrete approach to the Rhine-Meuse delta with regard to water storage and drainage, and the need for new dams or dikes.

www.ruimtevoorderivier.nl/english

BANGLADESH
INTEGRATED DELTA PLANNING

Name: **Bangladesh Delta**
Population: **155 million**
Urban or rural: **Rural, with several rapidly urbanising cities**
Above or under sea level: **Just above**
Total investment: **EUR 7.65 million**

Bangladesh, encompassing the Ganges-Brahmaputra-Meghna river systems, can in many respects be considered one of the most dynamic deltas in the world. Huge amounts of water and sediment often exceed the carrying capacity of Bangladesh' rivers. Cyclones and coastal floods, intensified by climate change effects, and a range of socio-economic trends, pose additional challenges. The Bangladesh Delta Plan 2100 (BDP2100) attempts to address these issues by developing a long term, holistic delta vision and adaptive strategy.

Amongst socio-economic trends are a rapidly increasing population and a growing demand for food. The already high pressure on available land adds to the complexity of water-related problems in the Bangladesh Delta, which all need to be addressed in order to support sustainable living conditions and continued economic growth.

The Bangladesh Delta Plan aims to deliver an umbrella development vision, strategy and implementation plan that can act as a frame of reference for new governmental policy, thereby supporting the integration of existing sectoral development plans. At the same time it aims to provide anchorage for numerous on-going projects and no-regret measures to delta challenges in the short term.

A range of stakeholders is involved in an interactive manner, ensuring the necessary institutional support for the development and implementation of the programme. BDP2100 links with the Five Year investment plans, which are coordinated by the Government of Bangladesh. Importantly, the Bangladesh Delta Plan will build on insights from the Dutch Delta Programme and the Mekong Delta Plan.

www.bandudeltas.org

FINANCE AND IMPLEMENTATION

INTEGRATED APPROACH

LEGISLATION AND DEPOLITISATION

GOVERNANCE AND COOPERATION WITH STAKEHOLDERS

EGYPT
NILE DELTA NEEDS A SHORELINE MASTER

Name: **Nile Delta**
Population: **10 million**
Urban or rural: **Urban and rural**
Sea level: **Just above**
Total investment: **EUR 2.4 million**

The Nile delta is heavily populated, with up to 1,600 inhabitants per square kilometre. The Nile delta coastal zone encompasses more than 40% of Egypt's industries and hosts vital centres for tourism, agriculture and fish farms. By the year 2075, a coastal area of about 500 km² will be vulnerable to flooding. The sandy barrier, separating the inland lakes from the sea, is very narrow and low lying, presently subject to strong erosion.

A UNDP report on climate change impacts estimates that hundreds of billions of Egyptian pounds, about 2 to 6% of future gross domestic product, could be lost from effects of climate change on water resources, agriculture, coastal resources and tourism. Thousands could die from air pollution and heat stress. Millions could lose jobs in agriculture as the result of climate change. In a middle scenario of sea-level rise, about 40 km² of agricultural land will be lost by the year 2060.

The Egyptian-Dutch High Level Water Panel, established 38 years ago, addresses these very urgent coastal zone challenges. Dialogues, knowledge exchange sessions and preparatory studies led to a public procurement for the development of an Integrated Coastal Zone Management strategy (ICZM) and a shoreline management plan for the Egyptian Mediterranean Coast from the Libyan border to the Gaza border. It should recognise, incorporate and address the concerns of all stakeholders through a well-defined and structured participatory approach.

Next to the tremendous natural challenges there are also a number of institutional and legal challenges. The institutional framework for addressing responsibilities in Egypt is complex and sometimes unclear. Cooperation among agencies is limited. The ICZM strategy must incorporate all required legislative and institutional changes that would facilitate the adoption, buy-in, and seamless development and implementation. The project, with a total budget of EUR 2.4 million, will be funded by Europeaid and should start by the end of 2014 and be finished within 30 months.

INTEGRATED APPROACH

SUSTAINABILITY, FLEXIBILITY, SOLIDARITY

SUPPORTED ANALYSIS

MYANMAR
MAKING USE OF THE RESILIENCE OF THE DELTA

Name of delta: **Ayeyarwady Delta**
Population: **6.6 million**
Above or below sea level: **+3 m**
Urban or rural: **Rural**

The Ayeyarwady Delta in Myanmar is extremely fertile. The area, which is plagued by floods, salinity and erosion, can play an important role in the economic development of this Southeast Asian country. The first step is to assess the vulnerabilities and, in particular, the resilience of the delta.

At about three metres above sea level, the
delta’s sediment plays a dominant role in the large-scale cultivation of rice. The delta region is densely populated and is dotted with fishing communities in villages and market towns,
mostly located along the rivers and streams.
That is why the destruction caused by Cyclone Nargis in May 2008 was so catastrophic, causing nearly 140 thousand casualties and severe economic damage.

Myanmar has asked the Netherlands to take the lead in drawing up an adaptive, integrated water management plan for both the delta and the rest of the country to cope with Myanmar’s expected huge economic growth and increasing pressure on water resources as a result of this. Delta Alliance Partners Deltares and Alterra are conducting a Vulnerability and Resilience Assessment Ayeyarwady Delta study, which is financed by the Global Water Partnership (GWP) and Bay of Bengal Large Marine Ecosystem (BOBLME).

The Ayeyarwady Delta is currently still, for the most part, underdeveloped. Uncoordinated exploitation of its resources in some areas may pose serious threats to the health of the delta. Effective, cross-sectoral management of the water system, in which local stakeholders are involved, will lead to sustainable solutions in the long term. The list of problems may seem long: Mangroves are cut down for fuel, there is overfishing, river bank erosion and deterioration of water quality as a result of salinisation. However, by applying Integrated Water Resources Management (IWRM), the delta can be used by the local people without compromising the integrity of these systems or overexploiting their natural resources.

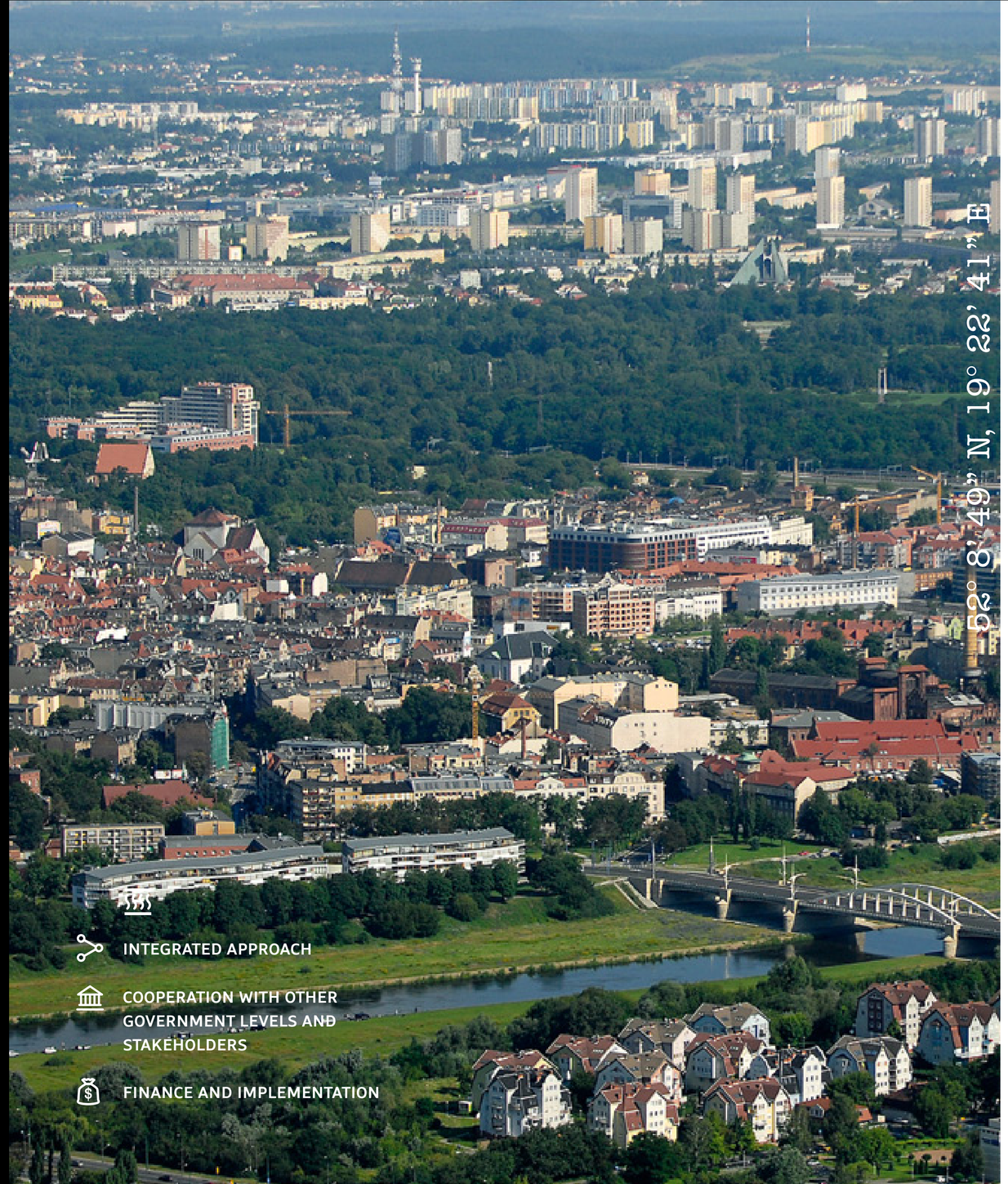
MOZAMBIQUE
A MASTER PLAN FOR BEIRA

Name: **Beira**
Population: **0.6 million**
Urban or rural: **Urban**
Sea level: **Just above**
Total investment: **Approx. EUR 2 million**

Beira and Rotterdam: two low-lying cities in densely populated deltas with ports serving a massive hinterland. People keep flocking to Mozambique's seaport and settling in low-lying areas that are not fit for habitation. Waterborne diseases, especially malaria, are rampant and the city's infant mortality rate is dramatically high. What can Beira learn from its Dutch counterpart?

Focusing solely on water safety and water supply in these neighbourhoods means you are only addressing part of the problem. In addition to water safety, the integrated approach of the Beira Master Plan 2035, which has been commissioned by the Beira Municipality and drawn up in consultation with all stakeholders in the city, aims to stimulate both land development and economic growth.
One important insight and result gained during the development process of the Beira Master Plan is the need for a public-private Land Development Company (LDC).
A company responsible for site preparation and for allocating suitable parcels of land for housing and business purposes. The Beira Municipality drew up the master plan in association with a Dutch consortium, aided by funding from the Dutch Global Water programme. The establishment of the LDC, again with help from the Netherlands, is currently underway.

The next step is preparing land development business cases aimed at generating concrete investment projects.
At the request of the Beira Municipality, Dutch experts will remain actively involved. Detailed financial engineering and the inclusion of crucial development partners will be the next step after that.



INTEGRATED APPROACH

COOPERATION WITH OTHER GOVERNMENT LEVELS AND STAKEHOLDERS

FINANCE AND IMPLEMENTATION

POLAND
WATER KNOWLEDGE HAS ECONOMIC POTENTIAL

Name: **Vistula and Oder Delta**
Population: **2 million**
Urban or rural: **Urban and rural**
Above or below sea level: **-1.8 m to +2.5 m**

Poland is a country of water, although it does not have a reputation as such. Almost all major Polish cities are located by the sea or a river and are directly influenced by water. Sometimes, as is the case with the Vistula and Oder Rivers, which run from the mountains in the south to the Baltic Sea and the low-lying, flat deltas in the north, the influence of water is too great. The one-dimensional river system set up in the past is highly susceptible to flooding.

In the last century, various Polish rivers were canalised and subsequently poorly maintained. Water management was considered an architectural problem, with concrete as the solution. Little attention was paid to the natural behaviour of rivers, resulting today in flooding problems causing annual flood damages of up to EUR 3 billion in 2010 alone. In addition, cities such as Warsaw and Cracow are unable to exploit the social, economic and ecological potential of their rivers to the full.

Awareness that things can and must change is gaining ground in Poland, which is also being affected by climate change. Economically, the Central European country is doing well. Poland is reaping the fruits of EU membership, also in terms of knowledge exchange. There are valuable lessons to be learned from the Netherlands and the Dutch Delta Programme in terms of its holistic, integrated approach to spatial planning and water management.

In the coming years, aided by Dutch knowledge and innovation and European funding, efforts will focus on ensuring water safety in the form of infrastructure, retention and limiting building in areas susceptible to flooding. This alternative approach will make room for nature while creating opportunities for tourism, recreation and nature development, both in flood plains and on city shores.

INTEGRATED APPROACH

SUSTAINABILITY, FLEXIBILITY, SOLIDARITY

SUPPORTED ANALYSIS

COOPERATION WITH OTHER GOVERNMENT LEVELS AND STAKEHOLDERS

VIETNAM
MEKONG DELTA PLAN: LONG-TERM VISION AND STRATEGY

Name: **Mekong Delta**
Population: **17 million (expected shrink to 15 or growth to 30 million)**
Urban or rural: **Urbanisation 28%**
Above or under sea level: **Greater parts + 1.5 m**

In the past decades, the Mekong Delta, with its rich land and water resources, successfully developed into the granary of the country and turned Vietnam into one of the leading rice exporters globally. On the other hand, the economic development of the delta lags behind other regions in the country. In its present state, the Mekong Delta is very vulnerable. Floods, droughts and salinity are dominant problems, hampering a prosperous and sustained economic development.

Inspired by the experiences in the Netherlands, the Government of Vietnam expressed the strong intention to work towards a Mekong Delta Plan for a safe, prosperous and both economically and environmentally sustainable development of the delta. It presents a vision to use the comparative advantages of the delta and focus on agro-business industrialisation. Organisation of the agricultural producers enables a better position to reduce transaction costs, platforms for more sustainable land and water resources management, improvement of product quality and competitiveness.

Diversification over the provinces is necessary to adapt as much as possible to available land and water resources. Important examples are a saline coastal zone with room for aquaculture integrated with mangrove restoration and in the upper delta controlled flooding with water retention and fish farming in the flood season instead of a third rice crop. Still, large-scale measures to guarantee flood protection and fresh water availability may be required when climate change causes persisting sea level rise and droughts.

The plan offers an assessment framework for government, donors and international financial institutions for moving from planning to implementation. The plan enjoys broad support – from the World Bank, the Asian Development Bank, the United Nations and countries such as Australia and Germany.

COLOMBIA
BALANCING INTERESTS AROUND THE CAUCA RIVER

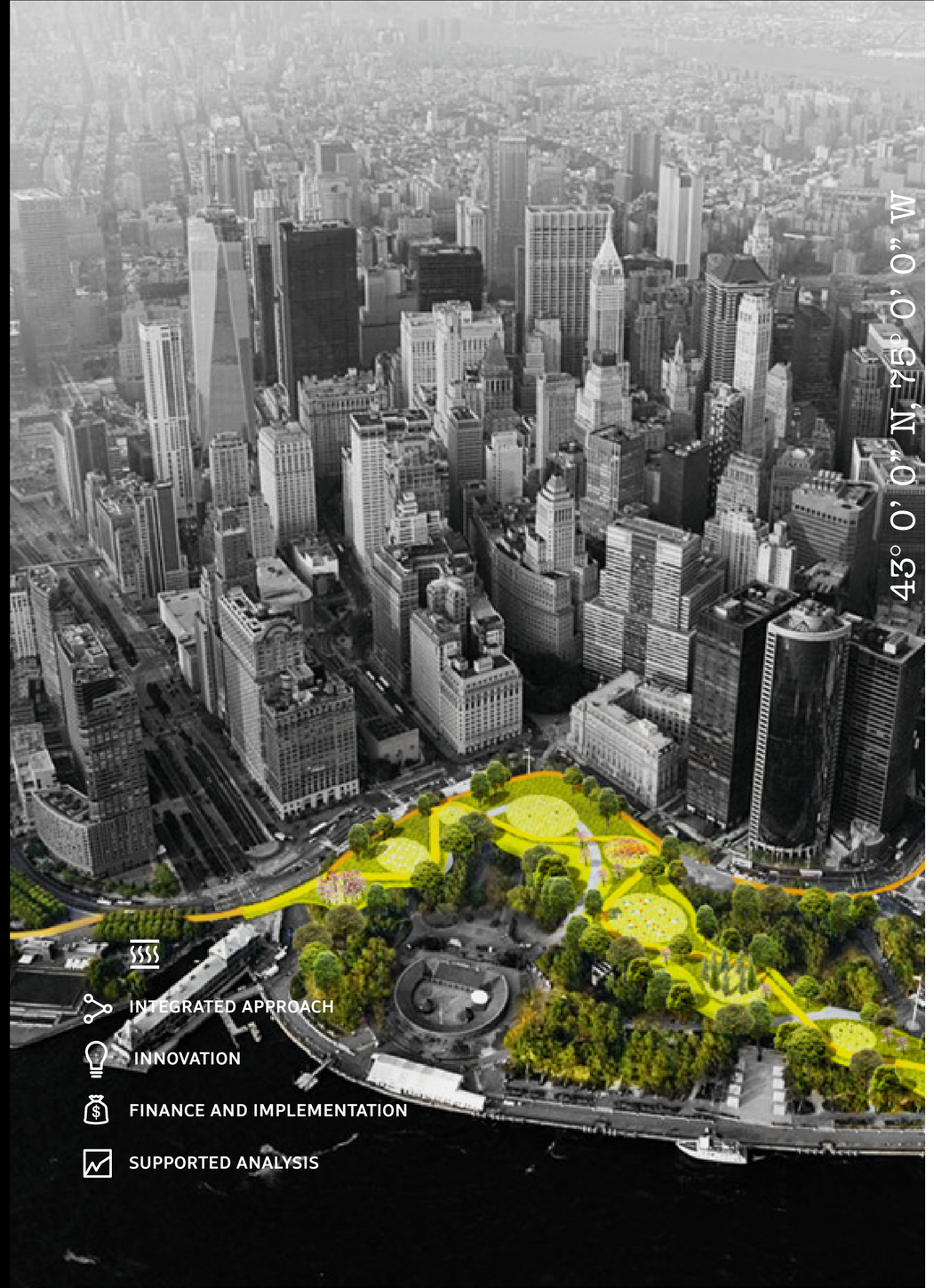
Name: **Upper valley of the Cauca River**
Population: **4,5 million**
Urban or rural: **Rural and urban**
Sea level: **+1,000 to +1,200 m**
Total investment: **Approx. EUR 2.5 million**

Inundation in the Cauca Valley has caused major socio-economic damage. As the valley is an important agricultural region representing the heart of Colombia's sugarcane industry, flooding also affects Colombia's national economy. The challenge is to limit the risk of flooding from the river and tackle the problem of insufficient drainage while paying sufficient attention to river ecology recovery. This requires balancing the interests of a large number of stakeholders.

Due to the flat nature of the Cauca Valley, the area suffers from frequent flooding, the last of which occurred in 2011. The ministry, the local councils and the farmers owning land adjacent to the river are all responsible for flood safety, which makes the process of reaching agreements far from easy.
The economic interests of the sugarcane farmers are great. To strike the right balance between the desired level of safety and a healthy river ecosystem it is vital that all stakeholders participate in the development and implementation of a flood risk management plan.

The Regional Autonomous Corporation of the Cauca Valley (CVC) plays a central role in this initiative. With support from a Dutch consortium, CVC experts analyse present water safety levels and assess the effects of potential measures.
They draw up a master plan using the experience from the Dutch Room for the River Programme. This includes an active participation of stakeholders and an integrated approach.

Dutch experience has shown that stakeholders need to be involved in an active and timely manner. It is important to provide the right level of detail during the development process, moving from general concepts to concrete actions. Ultimately, the individual landowners and local councils are responsible for the implementation of structural or physical measures. The CVC can assist in the implementation of non-structural measures such as subsidy programmes, training programmes, regulation and enforcement. The project also includes searching for funding from external sources, such as the World Bank or the Inter-American Development Bank.



NEW YORK (USA)
REBUILD BY DESIGN AFTER HURRICANE SANDY

Name of delta: **North East region USA**
Population: **NYC 9.5 million, New Jersey 8.8 million**
Urban or rural: **Urban**
Above or under sea level: +**2.5 metres (lowest point NYC)**
Total investment: **USD 930 million**

Hurricane Sandy painfully clarified the implications of climate change for the north-eastern region of the United States, exposing the vulnerabilities of the area. Since then the affected region has not just been rebuilt, but solutions are being sought that are in line with the natural and socio-economic characteristics of the region. Not a plan, but a culture change.

In the autumn of 2012, 650,000 homes and hundreds of thousands of companies in the largest metropolis of the nation were damaged or destroyed. In response, President Obama appointed the Hurricane Sandy Rebuilding Task Force in order to deliver aid, help and respond effectively and coordinate the rebuilding of the New York – New Jersey region. To become more resilient to climate change the Sandy Task Force, together with philanthropy, set up an ambitious project: Rebuild By Design (RBD).

After Hurricane Sandy revealed alarming infrastructural, environmental and social vulnerabilities, RBD assembled 10 teams (out of 148) of architects, engineers, planners and environmental scientists to undertake a regional research-intensive design process, identifying environmental concerns and developing strategies that will have a significant impact on the region and its communities. RBD is positioned not just to rebuild after the storm, but also to design a more sustainable and resilient region over the long term.

The designs combine innovation and regional strategy with location-specific, customised solutions. Each design team is made up of a coalition of local stakeholders including government officials, entrepreneurs, residents, researchers, NGOs and other organisations. This level of cooperation is unprecedented and has a strong Dutch flavour.

The same is true for the innovative designs – with members in six out of 10 teams, the Dutch are well represented here, too. The winning Rebuild by Design projects were announced in June 2014. The city of New York and the states of New York and New Jersey are responsible for implementation of the projects. An initial billion dollars of federal funding has been received for the realisation of the six projects.

www.rebuildbydesign.org

momentum, *leapfrog*

REBUILD BY DESIGN

Hurricane Sandy exposed complex, interdependent, regional problems throughout the Northeast: infrastructural governmental, economical, ecological, and social.

Complex problems need innovative solutions. Through innovation, we are building to a new standard, both on the ground and in policy design.

PROCESS
FUNDING
TALENT

Compete
+ HUD
$ Federal

- 148 teams competed
- Interdisciplinary from 15 countries: architects, engineers, scientists
- 10 selected

Research
+ Insitute for Public Knowledge, NYU
+ Municipal Art Society
+ Van Alen Institute
+ Regional Plan Association
+ Research Advisory Group
$ Philanthropy

- Studied region vulnerabilities
- Met with 57 government entities
- Met 145 people from 74 organizations
- Held 7 community conversations with community members and leaders
- Toured 30 neighborhoods
- Identified 41 opportunities

Design
+ State & Local Gov
+ Community Orgs
+ Local Stakeholders
$ Philanthropy

- 10 projects selected
- Teams work with states, mayors, community stakeholders, and experts
- Proving concepts for design solutions
- Pushing innovation while reflecting local, state, and regional priorities

IMPLEMENT
+All
$ Federal
$ Other Partnerships

- Rebuild smarter through design
- Drive change through how we build and how we legislate

BIG TEAM

BIG (Bjarke Ingels Group) with One Architecture, Starr Whitehouse, James Lima Planning + Development, Project Projects, Green Shield Ecology, AEA Consulting, Level Agency for Infrastructure, Arcadis, and the Parsons School of Constructed Environments

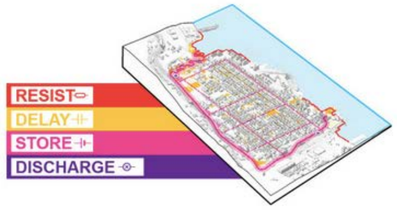
Go to BIG TEAM's page

HR&A Advisors, Inc. with Cooper, Robertson & Partners

HR&A Advisors, Inc. with Cooper, Robertson & Partners; Grimshaw Architects; Alamo Architects; Langan Engineering; W Architecture; Hargreaves Associates; and Urban Green Council

Go to HR&A Advisors, Inc. with Cooper, Robertson & Partners's page

OMA



OMA with Royal HaskoningDHV; Balmori Associates; and HR&A Advisors

Go to OMA's page

PennDesign/OLIN

PennDesign / OLIN with HR&A Advisors, eDesign Dynamics, Level Infrastructure, Barretto Bay Strategies, McLaren Engineering Group, Philip Habib & Associates, Buro Happold

Go to PennDesign/OLIN's page

Interboro Team

Interboro / Apex / Bosch Slabbers / Deltares / H+N+S / Palmbout / IMG Rebel with Center for Urban Pedagogy, David Rusk, NJIT Infrastructure Planning Program, Project Projects, RFA Investments, TU Delft

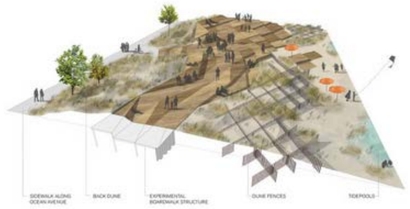
Go to Interboro Team's page

MIT CAU + ZUS + URBANISTEN

MIT CAU + ZUS + URBANISTEN with Deltares; 75B; and Volker Infra Design

Go to MIT CAU + ZUS + URBANISTEN's page

Sasaki/Rutgers/Arup



Sasaki Associates with Rutgers University and ARUP

Go to Sasaki/Rutgers/Arup's page

WB unabridged w/ Yale ARCADIS

Waggonner and Ball; unabridged Architecture; the Gulf Coast Community Design Studio; Yale's Urban Ecology and Design Laboratory; ARCADIS

Go to WB unabridged w/ Yale ARCADIS's page

WXY/WEST 8

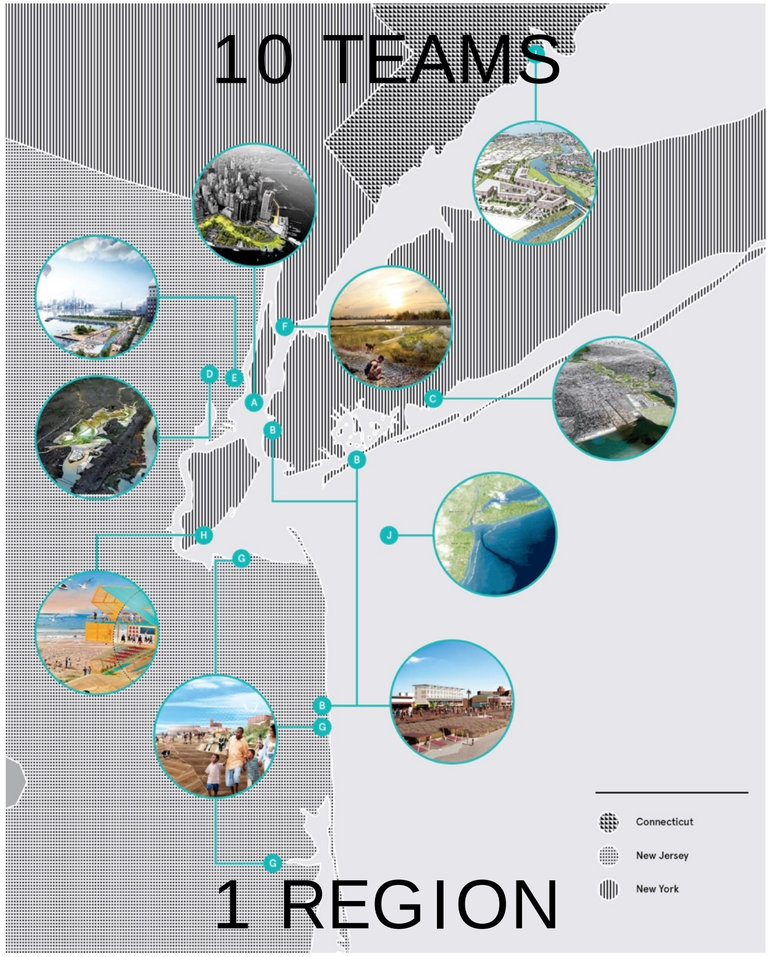
Dr. Alan Blumberg, Dr. Sergey Vinogradov, Dr. Thomas Herrington, Stevens Institute of Technology; Daniel Hitchings, ARCADIS; Andrew Kao, AIR Worldwide; Kate John-Alder, Rutgers University; Kei Hayashi, BJH Advisors; Maxine Griffith, Griffith Planning & Design; Yeju Choi, NowHere Office; William Morrish, Parsons the New School for Design; Jesse Keenan, CURE.

Go to WXY/WEST 8's page

SCAPE / Landscape Architecture

SCAPE/LANDSCAPE ARCHITECTURE with Parsons Brinckerhoff, Dr. Philip Orton / Stevens Institute of Technology, Ocean & Coastal Consultants, SeArc Ecological Consulting, LOT-EK, MTWTF, The Harbor School and Paul Greenberg.

Go to SCAPE / Landscape Architecture's page



IMPLEMENTATION - building and learning

Home About Proposals Teams Research Events Press Collaborators Videos Subscribe Contact Search ...

Working Together to Build a More Resilient Region

Home About Proposals Teams Research Events Press Collaborators Videos Subscribe Contact Search ...

Winning Proposals

LIVING BREAKWATERS

SCAPE / Landscape Architecture
Staten Island, New York

Hunts Point Lifelines

PennDesign/OLIN
Bronx, New York

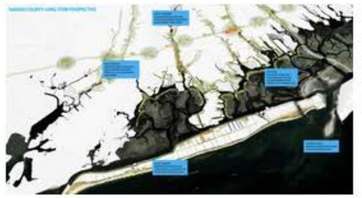
Resist, Delay, Store, Discharge: A Comprehensive Strategy for Hoboken

OMA
Hoboken, New Jersey

$920 M CDBG DR

New Meadowlands: Productive City + Regional Park

MIT CAU + ZUS + URBANISTEN
The Meadowlands, New Jersey



Living with the Bay: A Comprehensive Regional Resiliency Plan for Nassau County's South Shore

Interboro Team
Long Island, New York

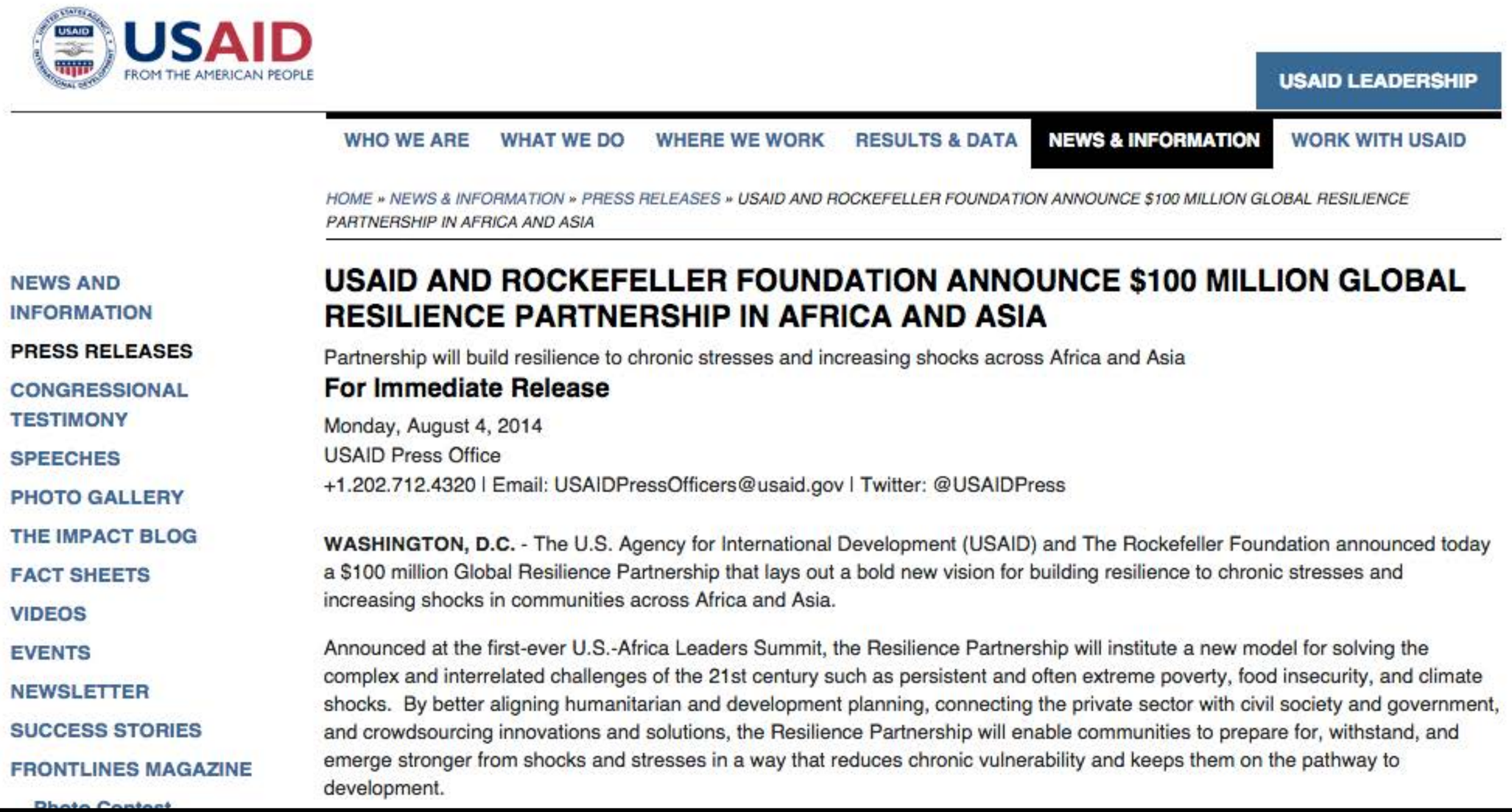
BIG U

BIG TEAM
New York, New York

REPLICATE NATIONALLY

"…building on the successful model set forth by HUD's Rebuild by Design competition."

REPLICATE INTERNATIONALLY



USAID
FROM THE AMERICAN PEOPLE

USAID LEADERSHIP

WHO WE ARE | WHAT WE DO | WHERE WE WORK | RESULTS & DATA | NEWS & INFORMATION | WORK WITH USAID

HOME » NEWS & INFORMATION » PRESS RELEASES » USAID AND ROCKEFELLER FOUNDATION ANNOUNCE $100 MILLION GLOBAL RESILIENCE PARTNERSHIP IN AFRICA AND ASIA

NEWS AND INFORMATION
PRESS RELEASES
CONGRESSIONAL TESTIMONY
SPEECHES
PHOTO GALLERY
THE IMPACT BLOG
FACT SHEETS
VIDEOS
EVENTS
NEWSLETTER
SUCCESS STORIES
FRONTLINES MAGAZINE

USAID AND ROCKEFELLER FOUNDATION ANNOUNCE $100 MILLION GLOBAL RESILIENCE PARTNERSHIP IN AFRICA AND ASIA

Partnership will build resilience to chronic stresses and increasing shocks across Africa and Asia

For Immediate Release

Monday, August 4, 2014
USAID Press Office
+1.202.712.4320 | Email: USAIDPressOfficers@usaid.gov | Twitter: @USAIDPress

WASHINGTON, D.C. - The U.S. Agency for International Development (USAID) and The Rockefeller Foundation announced today a $100 million Global Resilience Partnership that lays out a bold new vision for building resilience to chronic stresses and increasing shocks in communities across Africa and Asia.

Announced at the first-ever U.S.-Africa Leaders Summit, the Resilience Partnership will institute a new model for solving the complex and interrelated challenges of the 21st century such as persistent and often extreme poverty, food insecurity, and climate shocks. By better aligning humanitarian and development planning, connecting the private sector with civil society and government, and crowdsourcing innovations and solutions, the Resilience Partnership will enable communities to prepare for, withstand, and emerge stronger from shocks and stresses in a way that reduces chronic vulnerability and keeps them on the pathway to development.

"…building on the successful model set forth by HUD's Rebuild by Design competition."

Sandy, NY USA:
post disaster *clean up the mess*

>>

pre-disaster, prepare, be ready, resilient!

REPLICATE REGIONALLY

Building Regional Momentum
for More Resilient Communities

RESILIENT BY DESIGN

BAY AREA CHALLENGE

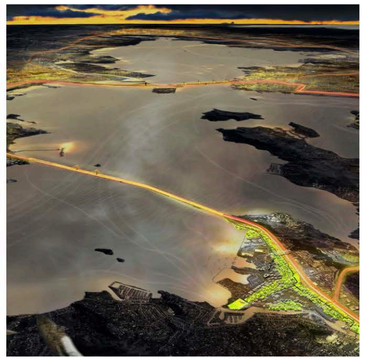
Bringing about a Stronger,
Safer Bay for Everyone to Enjoy

Creating a Blueprint for Resilience
that Harnesses Bay Area Innovation

Protecting Local Sites
Vulnerable to Sea Level Rise

MEET THE PROJECTS

These projects hope to inspire, catalyze action, and push us along the path to a more resilient future.



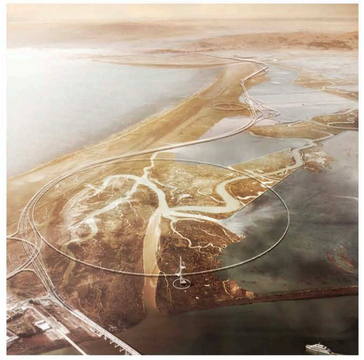
Elevate San Rafael (Bionic)

Unlock Alameda Creek (Public Sediment)

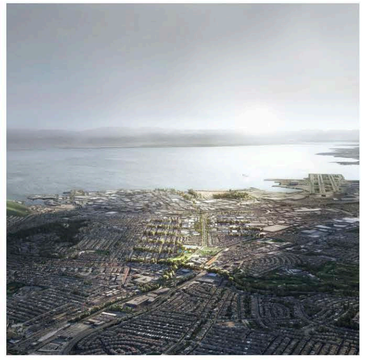
The Peoples Plan (P+SET)

South Bay Sponge (Field Operations Team)

Estuary Commons (ABC)



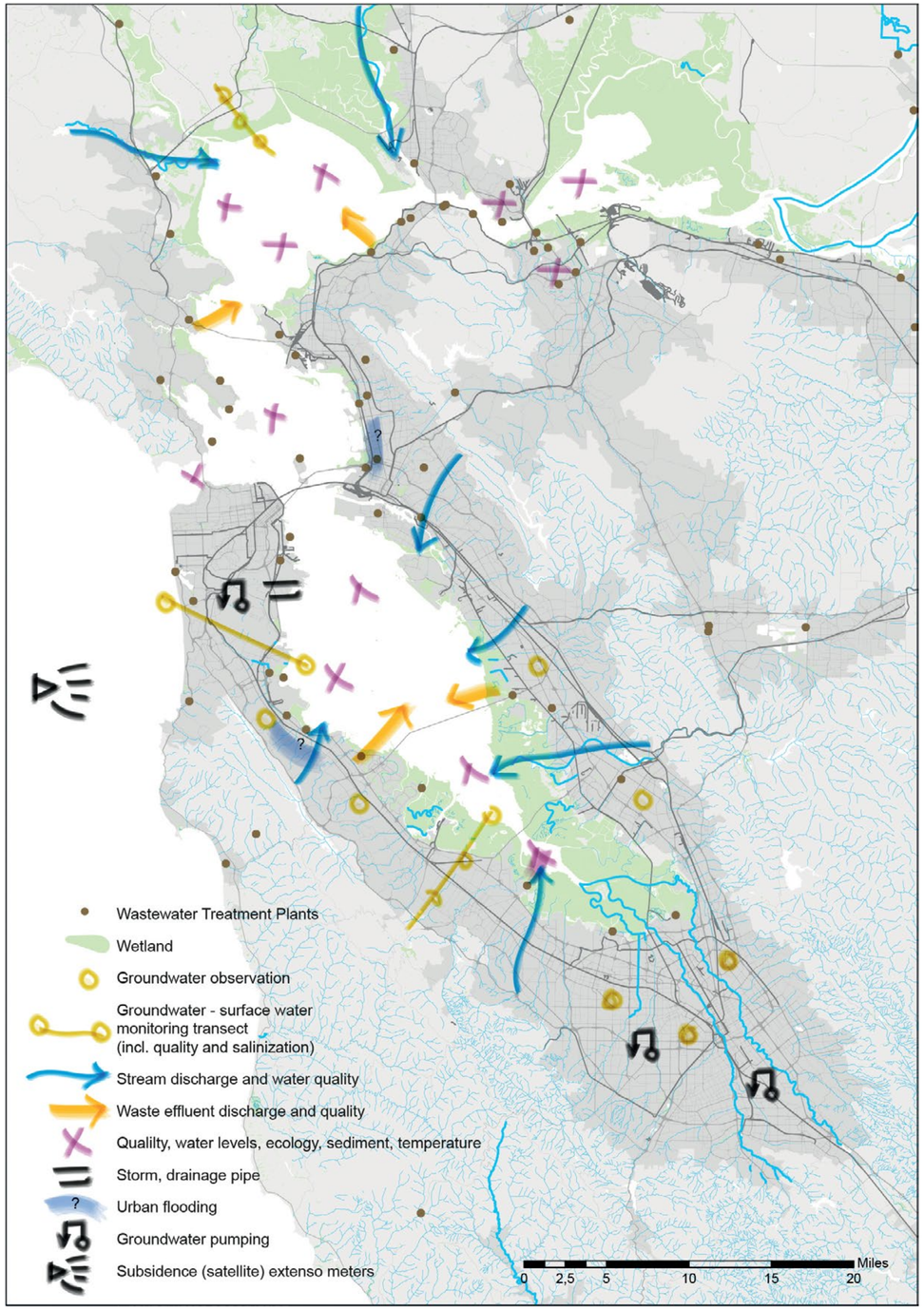
The Grand Bayway (Common Ground)



Connect and Collect (Hassell+)

ouR-Home (Home Team)

Islais Hyper-Creek (BIG+ONE+Sherwood)



Problems

TOO LITTLE

+

TOO MUCH

Local initiative meets Systematic change

Learning from Resilient by Design

Actions

Integrated design

Data collection

Bay area resiliency commissioner

Common vision

Awareness & contribution

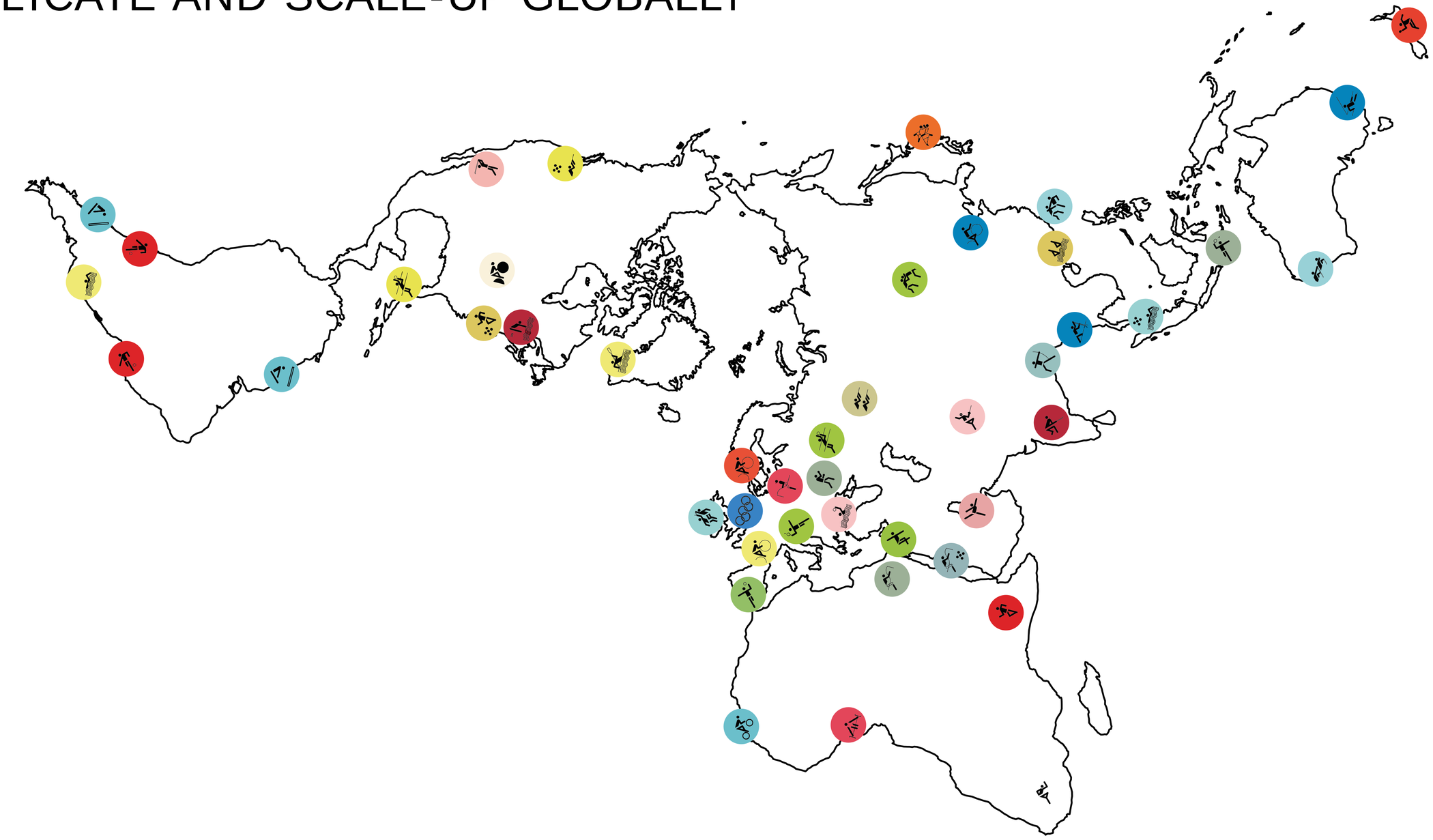
Benefits

RESILIENT BY DESIGN BAY AREA CHALLENGE

+

Integrate local initiatives & pilot projects into an integral large scale / system approach to increase resiliency effects

REPLICATE AND SCALE-UP GLOBALLY



Water for as Resilient Cities Leverage Asia

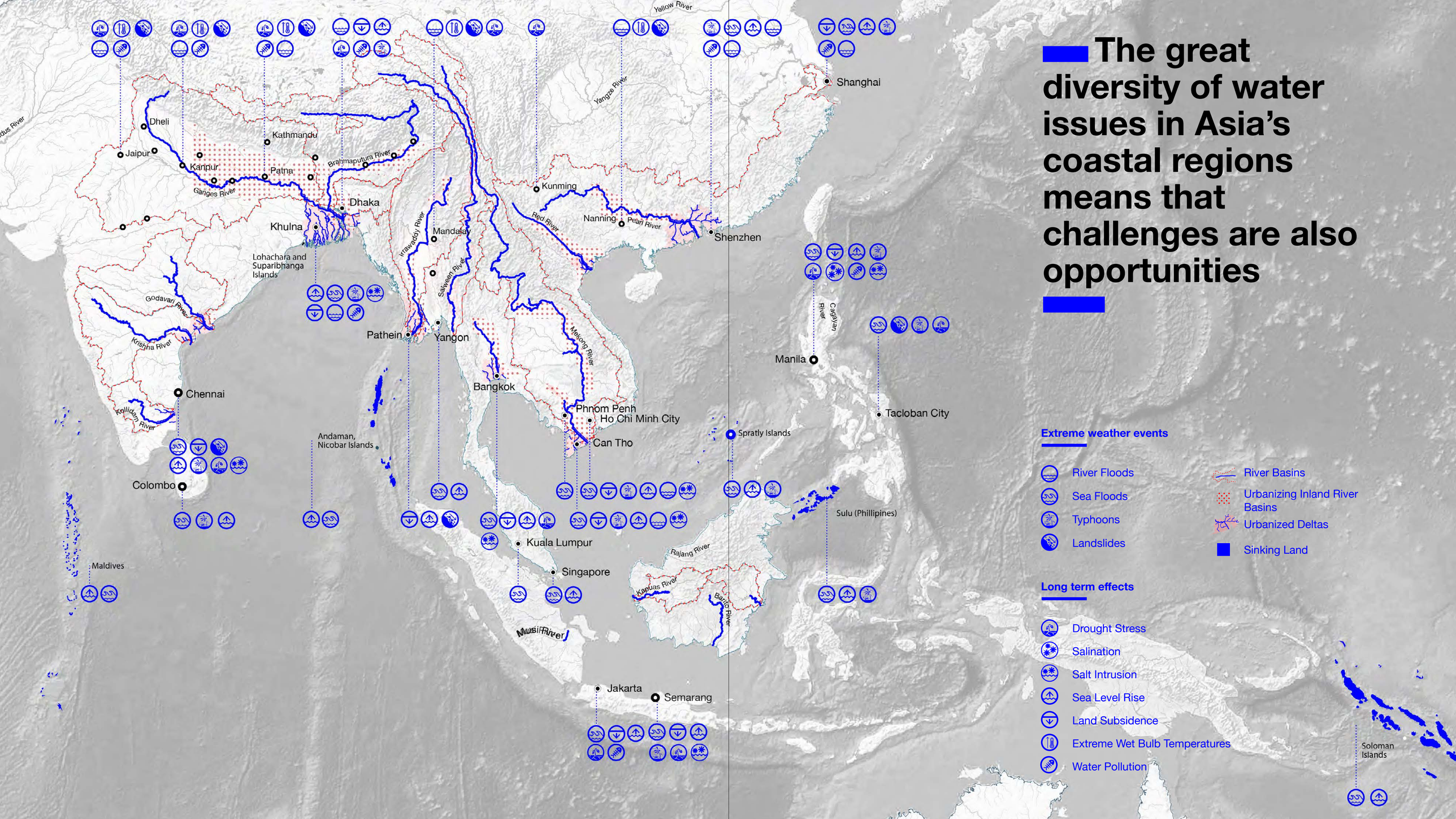
Kingdom of The Netherlands
Water Envoy

IABR—

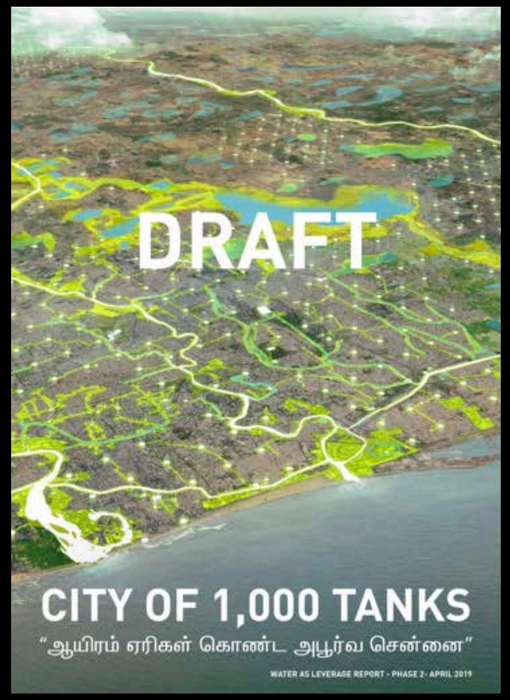
ASIAN INFRASTRUCTURE INVESTMENT BANK

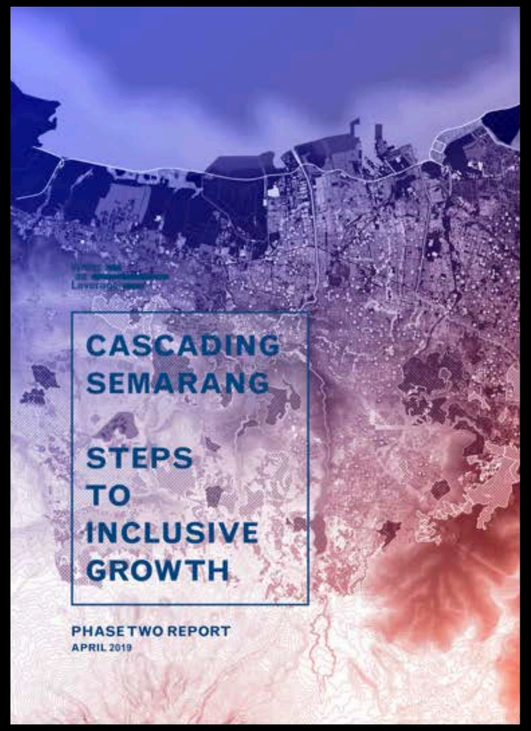
Global Centre of Excellence on Climate Adaptation

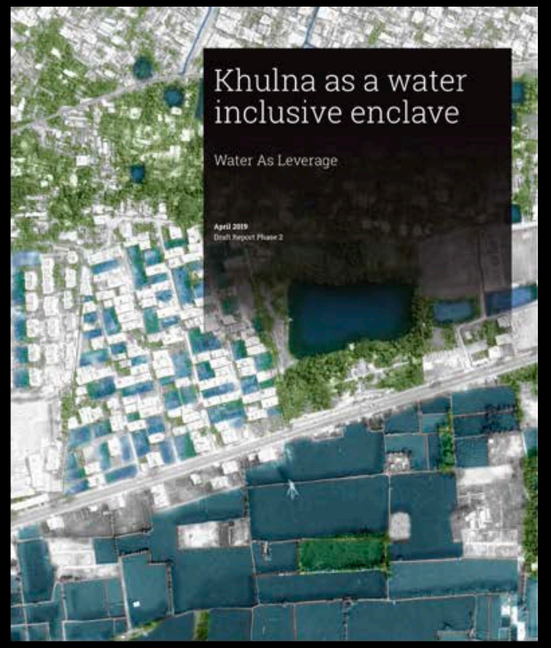
100 RESILIENT CITIES

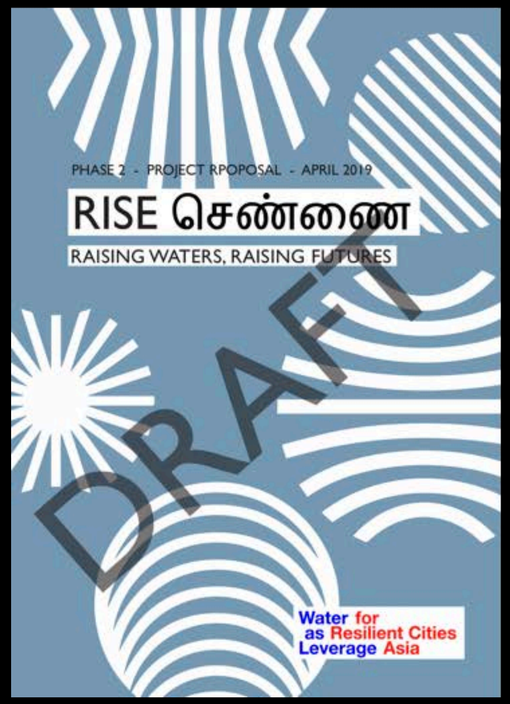

The great diversity of water issues in Asia's coastal regions means that challenges are also opportunities
Extreme weather events
River Floods
Sea Floods
Typhoons
Landslides
River Basins
Urbanizing Inland River Basins
Urbanized Deltas
Sinking Land
Long term effects
Drought Stress
Salination
Salt Intrusion
Sea Level Rise
Land Subsidence
Extreme Wet Bulb Temperatures
Water Pollution
Yellow River
Yangze River
Shanghai
Dheli
Kathmandu
Jaipur
Kanpur
Patna
Brahmaputra River
Ganges River
Dhaka
Khulna
Kunming
Red River
Nanning
Pearl River
Shenzhen
Irrawaddy River
Mandalay
Salween River
Lohachara and Supariibhanga Islands
Godavari River
Krishna River
Pathein
Yangon
Mekong River
Bangkok
Chennai
Kellidam River
Andaman, Nicobar Islands
Phnom Penh
Ho Chi Minh City
Can Tho
Spratly Islands
Cagayan River
Manila
Tacloban City
Colombo
Maldives
Kuala Lumpur
Singapore
Sulu (Phillipines)
Rajang River
Kapuas River
Barito River
Musi River
Jakarta
Semarang
Soloman Islands

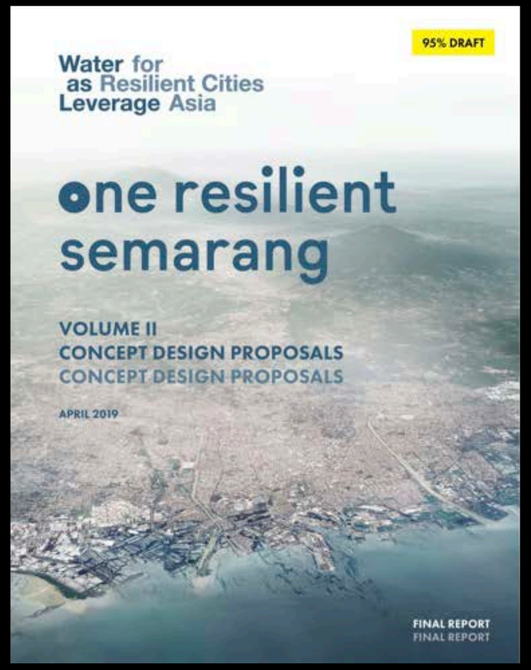
Shanghai
Yangze River
Indus River
Dheli
Brahmaputra River
Ganges River
Dhaka
Khulna
Red River
Pearl River
Shenzhen
Irrawaddy River
Godavari River
Krishna River
Pathein
Yangon
Mekong River
Cagayan River
Manila
Bangkok
Chennai
Bay of Bengal
Andaman Sea
Gulf of Thailand
Ho Chi Minh City
South-Chinese sea
Suba Sea
Colombo
Kuala Lumpur
Singapore
Rajang River
Celebes Sea
Kapuas River
Maldives
Musi River
Java Sea
Jakarta
Semarang
Banda Sea
Khulna (Bangladesh)
Kolkata
Semarang (Indonesia)
Chennai (India)
Buckingham Canal
Pulicat lake
Kosasthalaiyar River
Coovum River
Adyar River

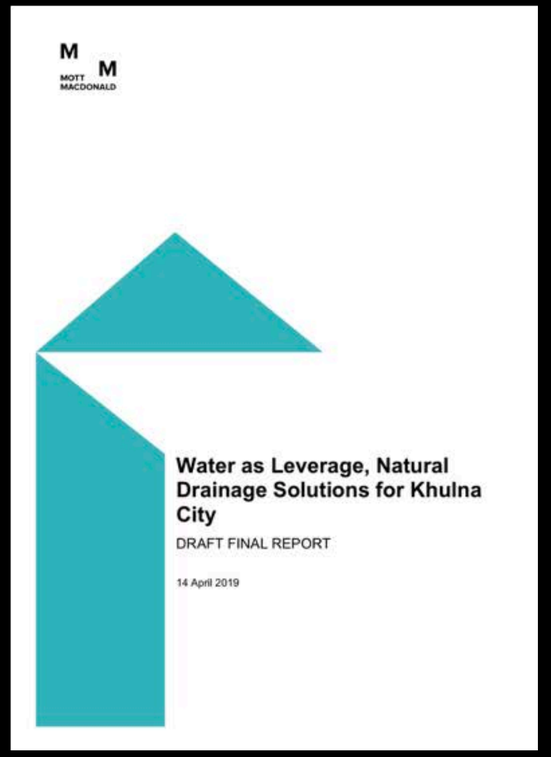

DRAFT
CITY OF 1,000 TANKS
"ஆயிரம் ஏரிகள் கொண்ட அபூர்வ சென்னை"
WATER AS LEVERAGE REPORT - PHASE 2- APRIL 2019


CASCADING SEMARANG
STEPS TO INCLUSIVE GROWTH
PHASE TWO REPORT
APRIL 2019

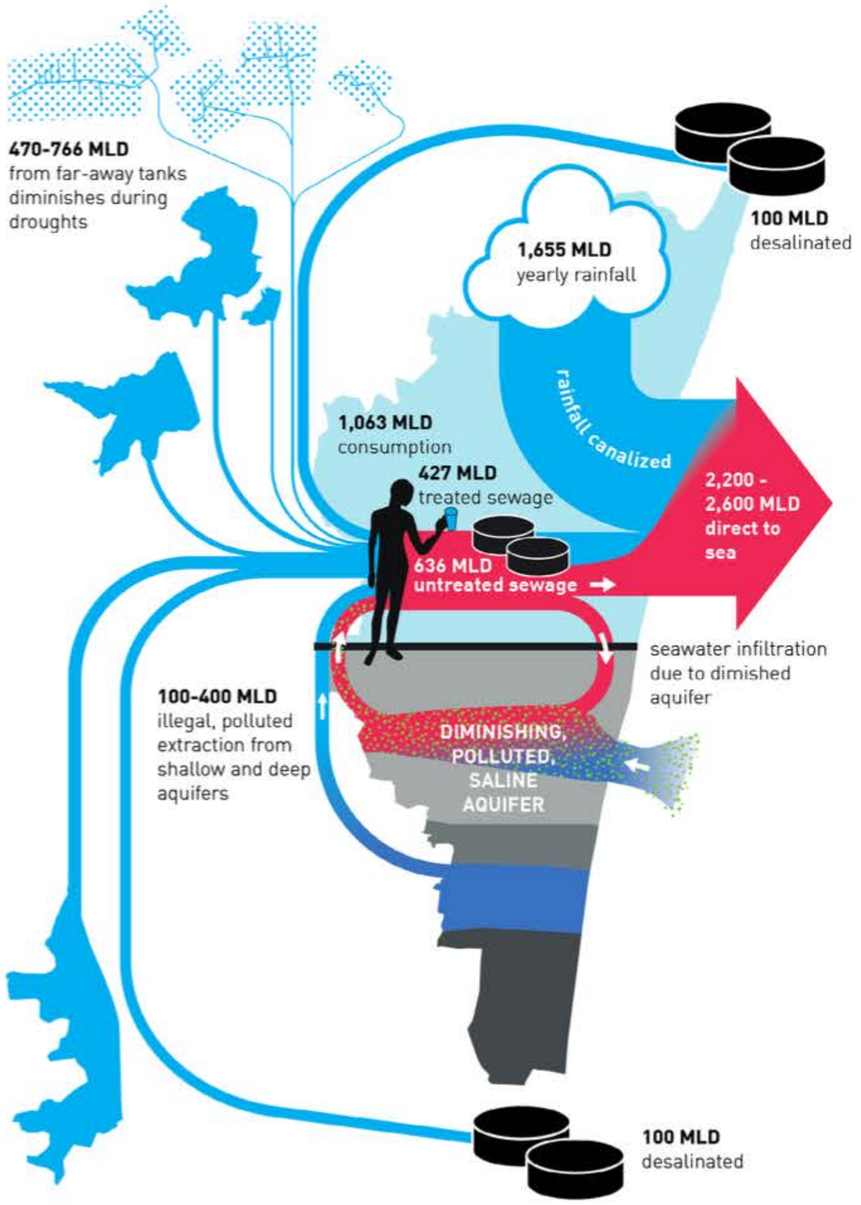

Khulna as a water inclusive enclave
Water As Leverage
April 2019
Draft Report Phase 2


PHASE 2 - PROJECT RPOPOSAL - APRIL 2019
RISE சென்னை
RAISING WATERS, RAISING FUTURES
DRAFT
Water for as Resilient Cities Leverage Asia

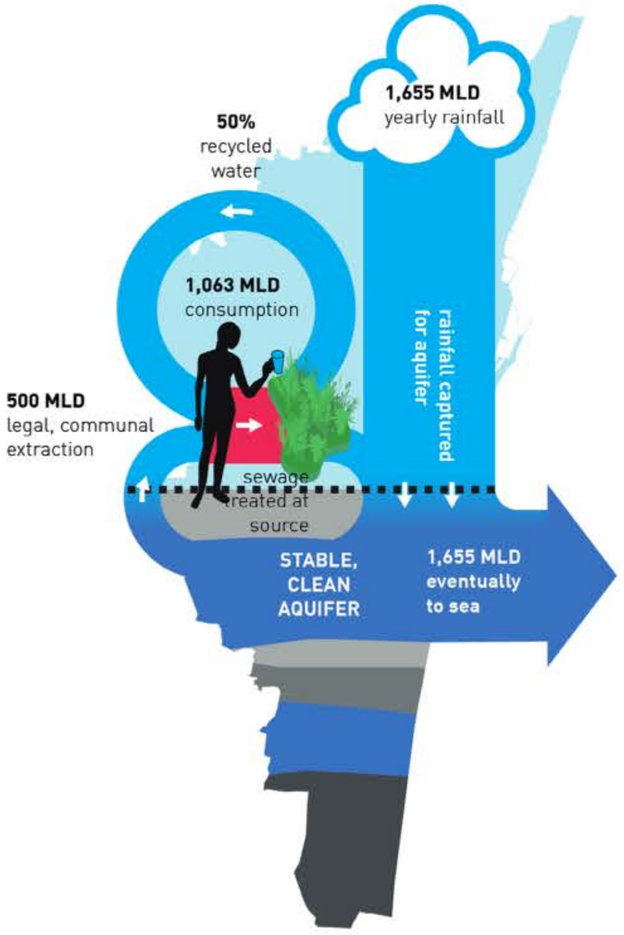

95% DRAFT
Water for as Resilient Cities Leverage Asia
one resilient semarang
VOLUME II
CONCEPT DESIGN PROPOSALS
CONCEPT DESIGN PROPOSALS
APRIL 2019
FINAL REPORT
FINAL REPORT

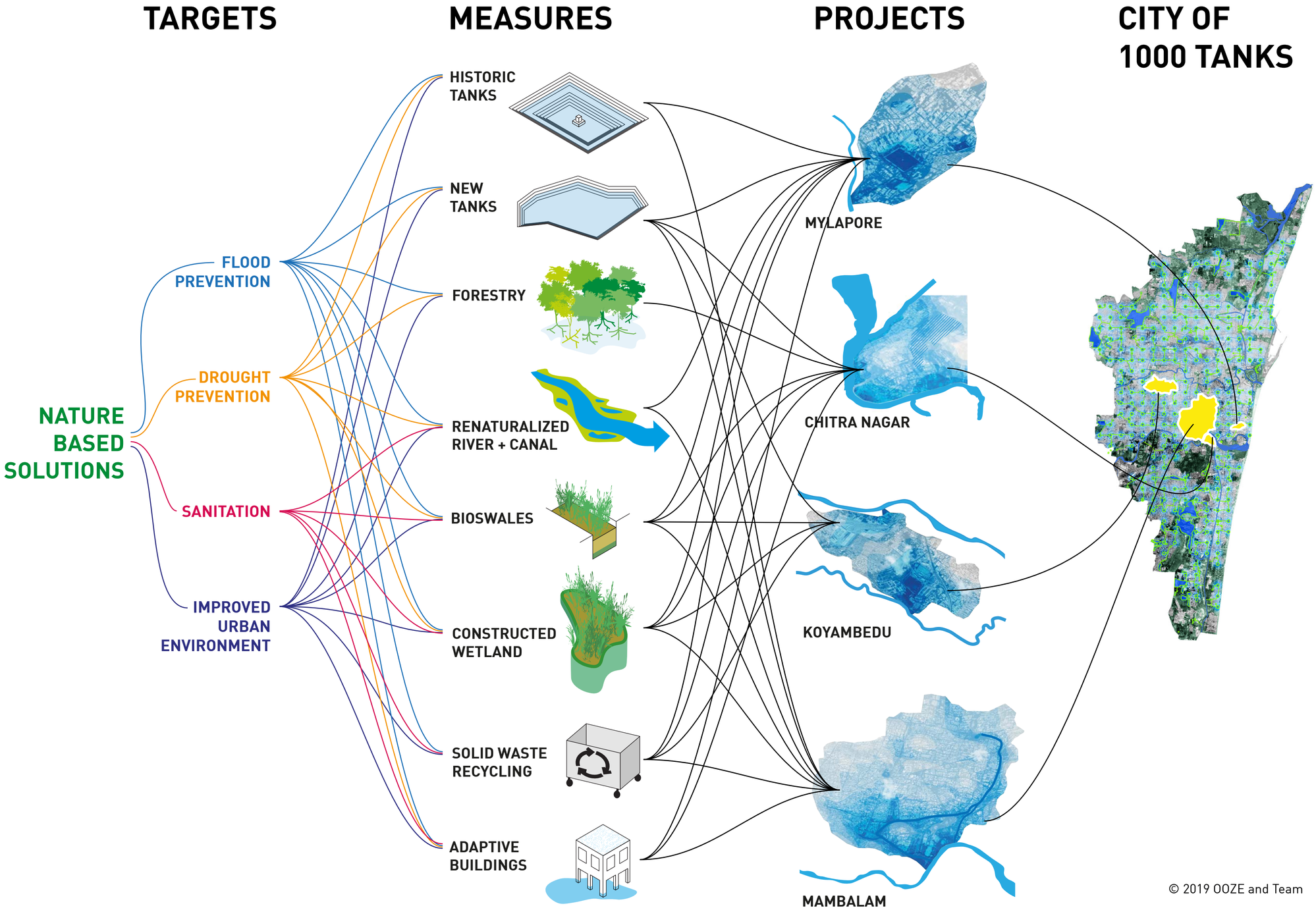

MOTT MACDONALD
Water as Leverage, Natural Drainage Solutions for Khulna City
DRAFT FINAL REPORT
14 April 2019

CURRENT SYSTEM
SCARCITY



PROPOSED SYSTEM
CLOSED LOOP



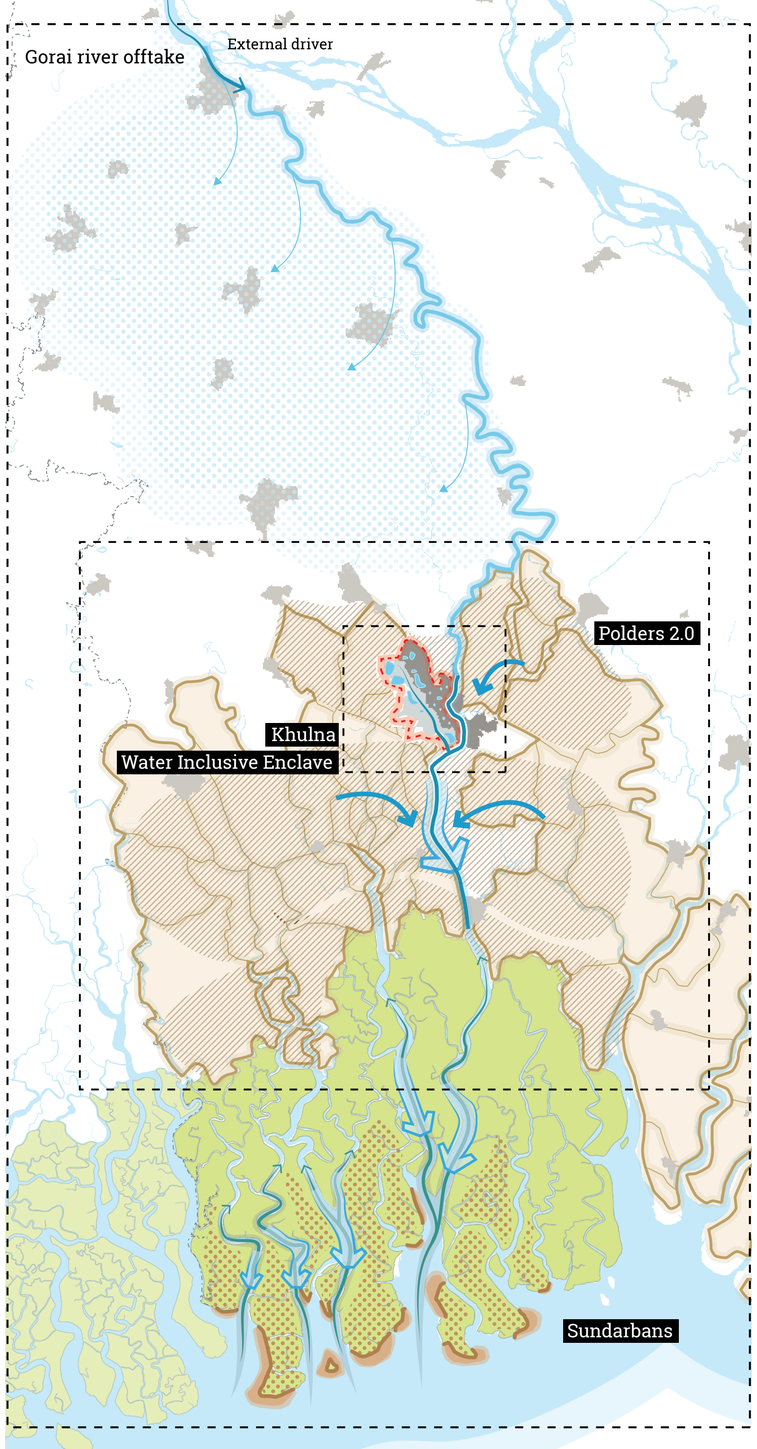


PROGRAM PROPOSALS

water(shed) as leverage

one resilient semarang

3 project scales for Khulna



A Floodplain scale

- Gorai offtake restoration (outside scope)
- Extending the Sunderbans (feasibility)

B Regional scale

- Sustainable agriculture polders (feasibility)

C City scale

- Khulna water inclusive enclave
  1. 100 ponds project (proposal)
  2. Mayur river (proposal)
  3. Multi level city (proposal)

Florida
a water *resilient state*

TAMPA BAY

REGIONAL RESILIENCY COALITION

BIKE ! WALK

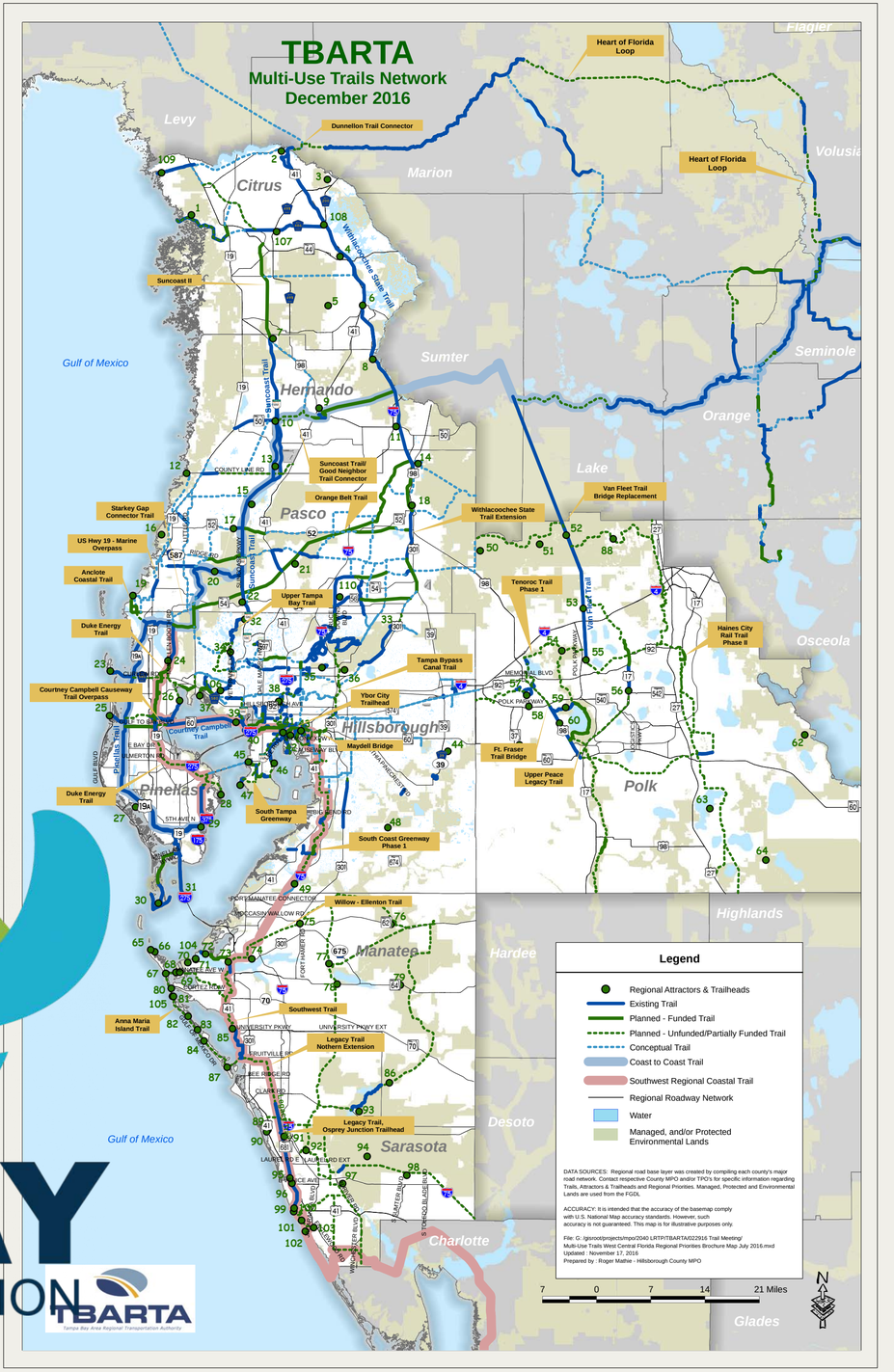
A regional coalition of TAMPA BAY

COALITION PROGRESS REPORT

2018

TAMPA BAY

REGIONAL RESILIENCY COALITION



Coastal Resilience – Mapping po | Coastal Resilience | Gulf of Mexic | Arkema et al 2013_Nature Climat | (16) (PDF) COASTAL RISKS, NATU

https://maps.coastalresilience.org/gulfmex/

Coastal Resilience Gulf of Mexico

Find address or place

- Get Started
- Regional Planning
- Community Rating System
- Community Planning
- Habitat Indicator Explorer
- Risk Explorer
- Flood & Sea Level Rise
- Future Habitat
- Economics of Coastal Adaptation

Tour

Risk Explorer

Risk = Exposure x Vulnerability

Exposure is scored using seven bio-geophysical variables

- With Sea Level Rise
- Without Sea Level Rise

Vulnerability is scored using your choice of social vulnerability variables

- Total Population
- Older Population
- Families in Poverty

Layer Visibility

- Risk Score = Exposure x Vulnerability
- Priority conservation areas where habitats likely reduce risk now

Lowest
Medium
Highest

Methods

Topographic

Photo by Marty Moeller

City of Tampa, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS | q

6km
4mi

4:22 PM
3/19/2019

NO SILVER BULLET - NOT EASY

NO SILVER BULLET - NOT EASY

BLUE MARBLE Dec 7 1972, Apollo 17


Greetings from
TAMPA
BAY